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eti ELECTRONICS TODAY INTERNATIONAL

Bumper project issue!

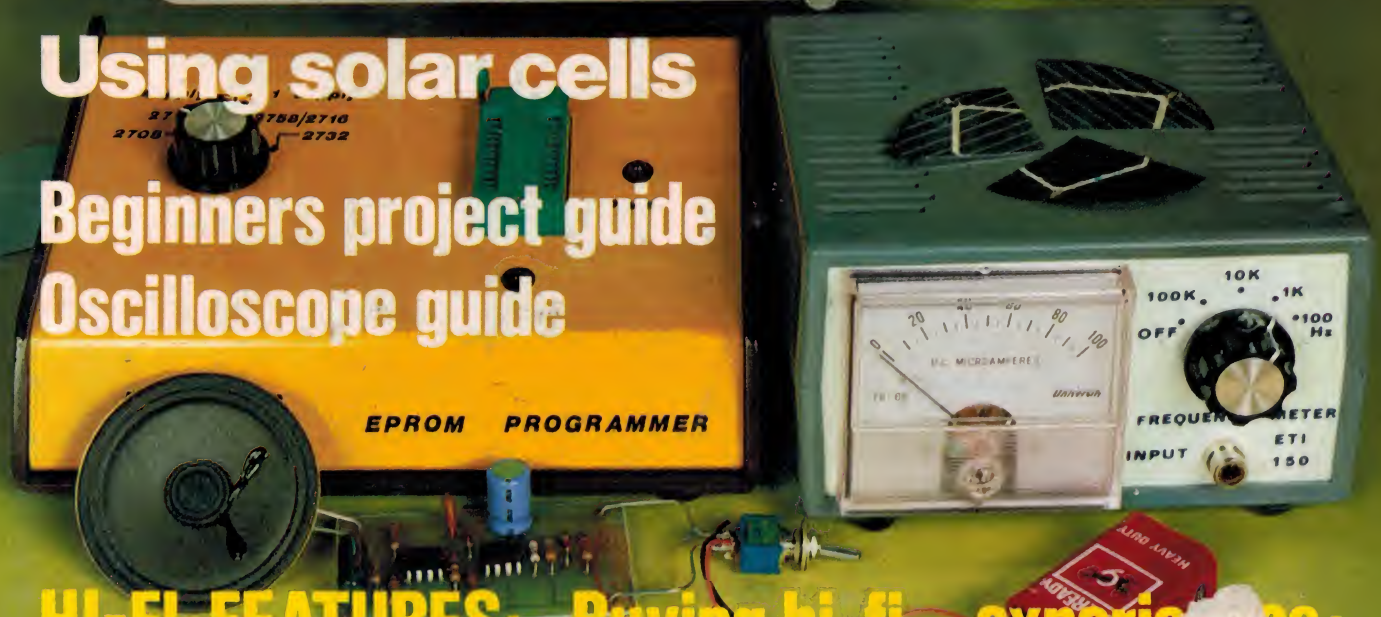
*EPROM programmer

*Analogue frequency meter plus seven simple projects

Using solar cells

Beginners project guide

Oscilloscope guide



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Reviews: Advent, Sirius spkrs plus economy Pioneer cassette.

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When Maxell announces an improvement in the quality of its tape, you can bet the improvement has to be pretty dynamic. In fact, we think our new generation has even gone beyond our own standards of superior sound reproduction.

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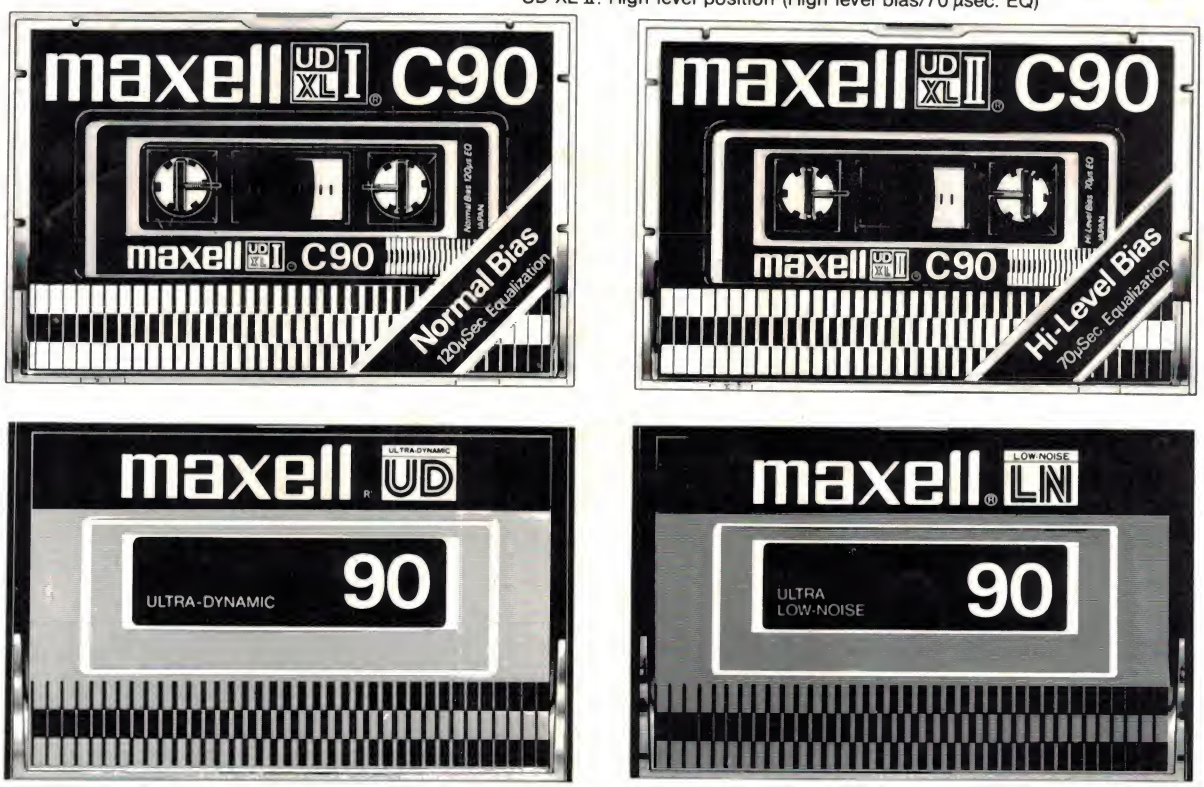

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Available time length UD-XL I: 60, 90 min./UD-XL II: 60, 90 min.
UD: 60, 90, 120 min./LN: 60, 90, 120 min.

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eti ELECTRONICS TODAY INTERNATIONAL

WITH MECHANICAL THINGS you can at least see what's going on. With electronics, it's not possible. To look 'inside' an electronic circuit, there's nothing to beat **the ubiquitous oscilloscope.** That's the title of our lead feature this month – it's a look inside this useful instrument, from how the cathode ray tube works, to its own internal circuitry, to how to choose one to suit your needs.

If you compare the energy conversion efficiency of fossil fuels and **solar cells**, the latter are way out in front. The day when solar cells provide a significant proportion of our energy requirements seems not too far off. Starting page 28, we have a feature on these useful little diodes with some practical hints and experiments.

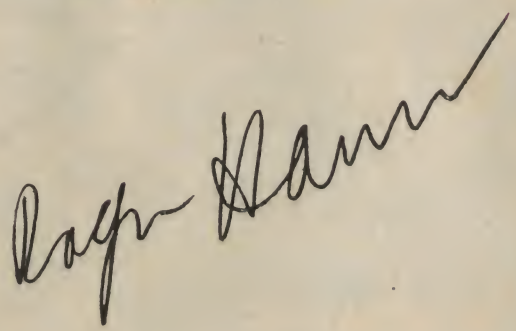
For beginners we have a **project building guide** and a host of **simple projects**, including a **solar-powered receiver!**

Do you find shopping for hi-fi equipment a pleasure or a pain? "It is the hi-fi retailer's aim to tell you only facts", claimed an article in a recent newspaper feature on hi-fi. Hmmm. A correspondent has done a **survey of hi-fi retailers** and come up with some startling, and highly amusing, observations that seem at variance with that quote. In our **sound reviews** this month we look at **Pioneer's CT-F650 cassette deck**, a $299 machine with memory and metal tape facility amongst other features, followed by the **'new' Advent loudspeaker** and Philips' **Sirius System 1400 loudspeaker.**

Have a **good read.**

Season's greetings to all our readers and advertisers from the staff of ETI.

Roger Harrison, Editor



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Our cover this month presents a brief insight into this month's main attractions. Another Ivy Hansen creation.

THE INS AND OUTS OF SOLAR CELLS 28

A timely and practical look at solar cells, how they work and how to use them — plus a few circuits to experiment with.

THE OSCILLOSCOPE 16

Oscilloscopes must be one of the most useful instruments ever invented. Here is a guided tour inside the oscilloscope, how it works and how to choose one, plus a full suppliers' listing.

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A locally-made speaker, these show up quite well for a 'budget' priced system.

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Plus Christmas and New Year celebrations all rolled into one . . .

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GUITAR PRACTICE AMPLIFIER
This project has been designed to enable guitarists to put in long hours of practice and still keep peace with the neighbours! It is compact, straightforward, has two inputs and will deliver 7 W into 4 ohms.

A LITTLE LIGHT ON LEDS
A good meaty article on LED characteristics, uses and abuses of LEDs plus a host of indicator circuits, chasers and displays. Not to be missed.

UPGRADING YOUR HI-FI
You've progressed to a "good" system and have enjoyed the equipment for some time, but you'd like to go further — here's a guide of what and where to look next.

COURSES IN ELECTRONICS
If you're considering a career in electronics, at whatever level, or just thinking about doing a formal course as part of your hobby, then our guide to what courses are available and what might become of you when you're finished, should be of great interest. Don't miss it!

Although these articles are in an advanced state of preparation circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

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READER ENQUIRIES

By Mail: There is no charge for replies but a foolscap-size stamped addressed envelope **must** be enclosed. Queries relating to projects can **only** be answered if related to the item as published. We cannot advise on modifications to projects, other than errata or addenda, nor if a project has been modified or if components are otherwise than specified. We try to answer letters as soon as possible. Difficult questions may take time to answer.
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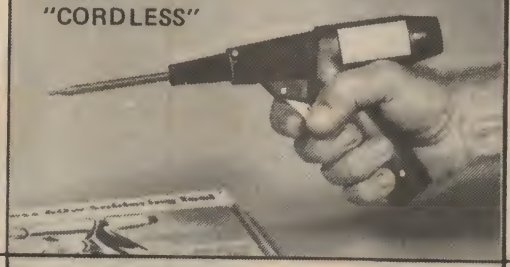
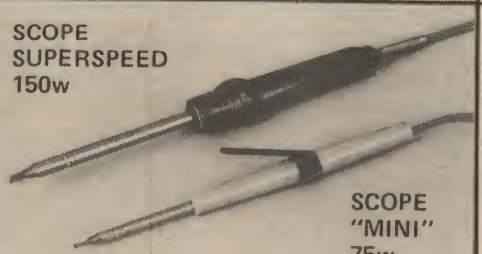
• No power • No time to get power • Must work on live gear	SCOPE "CORDLESS" 	1. 40–200 Terminations depending on conductor size. 2. Recharges overnight. 3. Heats in 6 seconds. 4. 60 watts – Controllable temperature.
• 12 volt. Battery power available only. • Outdoor and bad weather expected. • Service vehicle can get within 6 metres.	 SCOPE "12VOLT SUPERSPEED"	1. 5 Second heating. 2. 200 watts if needed. 3. Controllable temperature. 4. You can replace tip or element anywhere in minutes.
• Modern sophisticated PCB equipment. • Accurate & automatic temp. control wanted. • Components are heat critical.	SCOPE "TC60" 	1. Heats in 45 seconds. 2. Dial any temp. 200°–400° 3. Plugs direct to mains. No transformer needed. 4. Accept iron plated tips from 0.8mm to 6.4mm.
• Unpredictable soldering situation. • Maybe electrical or electronic or mechanical. • You can't come back to base for a bigger or smaller iron.	SCOPE SUPERSPEED 150w  SCOPE "MINI" 75w	1. 5 second heat up. 2. Controllable temperature. 3. Reserve heat for any normal job. 4. 4 volt safety in the hand.

For further information telephone your nearest Scope agent:
NSW (02) 546-6144. **QLD** (07) 221-1933. **SA** (08) 223-2261. **WA** (09) 381-4155.
TAS (003) 31-5545, (002) 34-2811. **NZ** (4) 85-9578, (9) 54-6029.

SCOPE LABORATORIES
Box 63 Niddrie Vic., 3042.
Phone: (03) 338 1566. TLX 34382.

NEWS digest

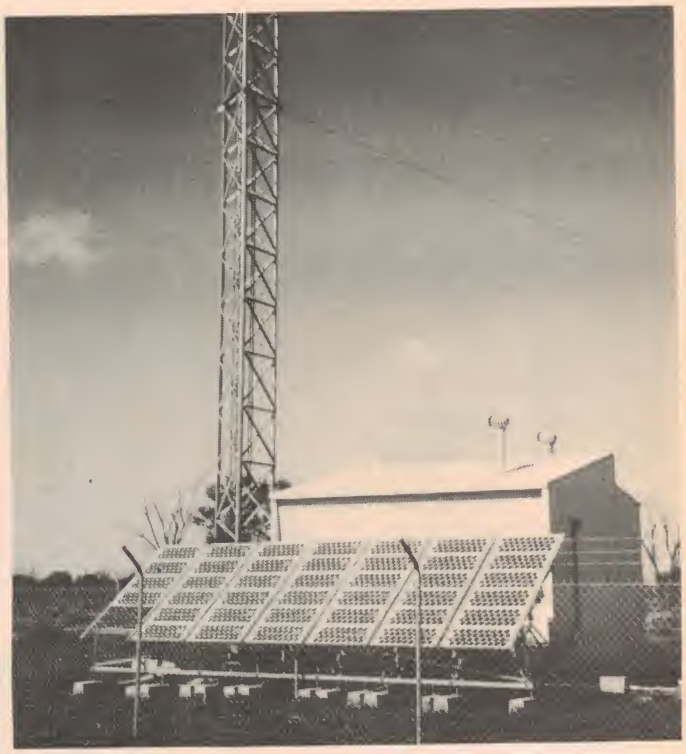
Solar power for railway communications

Australian National Railways is to use solar power to energise the greater part of a communications system along the 831 km length of the Tarcoola-Alice Springs railway.

The communications system will incorporate an integrated microwave — VHF radio system with 72 channel capacity. It will span 850 kilometres and have 26 repeater stations and two terminals at intervals of about 35 kilometres.

Each repeater station will have its own solar power unit with an output of 1400 watts.

The 23 powered sites will use Chloride Batteries Australia Ltd's SPT 31 batteries specifically designed for solar applications where a long period of summer and winter charge/discharge cycle is superimposed on daily operating conditions.



Solar polar mission

A combined European/US space project planned for 1983 is expected to give man his first look at the polar regions of the Sun. These regions cannot be seen from Earth or from satellites in Earth orbit.

Under an agreement signed between the European Space Agency (ESA) and the US National Aeronautics and Space Administration (NASA), two spacecraft will travel in orbits passing directly over the Sun's poles. The craft will be provided by ESA and NASA, while Britain, Federal Germany, France and Switzerland will supply experiments for the craft.

Under an $8 million contract announced in October, the British Aerospace Corporation will be providing equipment for control of the European satellite's altitude and orbit in space.

The two spacecraft will be launched together from the American space shuttle vehicle, February 1983 being the proposed launch date. They will be directed towards Jupiter along similar trajectories, using booster rockets, and will then swing around the planet, using its gravity to redirect their paths into orbits passing directly over the north and south poles of the Sun.

Scientists believe that by sending the craft over both poles simultaneously, they will be able to compare solar and inter-planetry phenomena affected by the differences in activity between the northern and southern solar hemispheres.

These phenomena affect the velocity, composition, density and magnetic field structure of the solar wind which reaches the outermost layers of the Earth's atmosphere.

A secondary objective is to obtain new information about the magnetosphere of Jupiter during the fly-past in mid-1984. A total of more than 150 European and US scientists will be involved in the four-year project, known as the International Solar Polar Mission.

Programmable timer

Western Digital have designed a flexible multi-stage timer which they claim requires a minimum of external components.

Called WD55, time intervals are entered either by keyboard, toggle switches or slide switches. A built-in LED display indicates the amount of time left for any programmed sequence. Up to seven individual sequences can be called up, and an on chip oscillator is available for audible warning when the end of a time out period occurs.

The device comes in a 40-pin package and operates from a 12 V dc power supply. Applications include timers for darkrooms, irrigation, process controllers, lighting control, traffic lights and security controls.

Distributed by Daneva Control Pty Ltd, 70 Bay Rd, Sandringham, Vic 3191 (03) 598-5622.

Measuring sky temperature

Solar engineers at CSIRO's Division of Mechanical Engineering have designed an extremely sensitive instrument which accurately measures sky temperature.

Sky temperature, which is not the same as ambient or air temperature (and is often well below it), is an important factor affecting the performance of solar collectors.

As it has been very difficult to measure, sky temperature is usually estimated, but when solar researchers are correlating the measured performance of a collector with meteorological data it is most desirable to have complete information on all the climatic factors affecting its output.

The sensor developed by the Melbourne-based Division operates by accurately monitoring incoming solar and thermal radiation, and outgoing thermal radiation.

The sky temperature is then derived from a mathematical equation that links the measurements with three experimentally derived physical constraints.

The researchers hope to incorporate electronic equipment to process the variables in the device so that the sensor could then display the sky temperature digitally.

The sensor can measure sky temperature both day and night and is unaffected by wind and sunshine.

The Division is particularly interested in inquiries from prospective manufacturers of the sensors. It is not intended to patent the thermometer.

Though the market for such a device in Australia is probably limited, the Division believes it could be widely sought for research work in Europe and North America.

Information can be obtained from the Division by telephoning (03) 950 333.

Leader portable CRO

The Leader LBO-308 is a new 85 mm (3") triggered oscilloscope which can be operated either by dc power, rechargeable battery pack or ac power source. It has a high sensitivity of 2 mV and a bandwidth from dc to 20 MHz.

All controls are located on the front panel to enable easy operation. These include the new TV sync circuit for simple triggering or composite TV signals, phase /level comparison of signals and addition/subtractor function for correct indication of push-pull signal.

Leader instruments are distributed by Vicom, 68 Eastern Rd, South Melbourne Vic 3205, (03) 699-6700. They will advise your nearest outlet.

Tandy catalogue

Tandy Electronics have released their 1980 catalogue, a 144 page listing of all Tandy products, including cassette recorders, radios, turntables, AM/FM receivers, speakers, intercoms, PA systems, CB equipment, calculators, scanners, antennas and so on, as well as many new products.

Over 400 000 copies of the catalogue will be available from Tandy stores and participating franchised dealerships throughout Australia.

Electronics reading machine

A machine which converts written text to spoken sound has been developed by Kurzweil Computer Products of Cambridge, Mass, USA.

The machine contains an optical scanner, a small computer incorporating a speech synthesizer, and a loudspeaker unit.

The page to be read is placed over the scanning unit which then converts the written text to digital signals which are then fed to the computer. The computer is programmed to convert the digitized text into sound in a similar fashion to a person speaking . . . the device will pronounce the combination 'ough' as 'ow' or 'off' or 'oo' in words such as 'bough', 'cough', or 'through' respectively.

Syntax analysis is also incorporated to ensure that the right stress is placed on the correct word in a sentence.

The optical system can accommodate a very wide range of type faces but must be preprogrammed to do so — it cannot at present automatically adapt to variations.

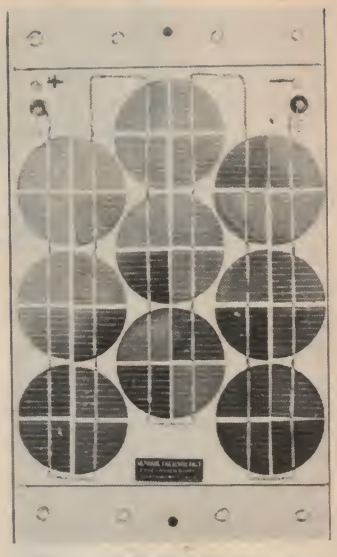
If proven successful the machine offers enormous benefits to blind people — it is currently being tested for this purpose by the Royal National Institute for the Blind in the UK.

Solar Panel

Sensor Technology Inc have just released the smallest of their range of solar panels, model SP144015. This unit measures 170 x 280 x 20 mm and produces a power output of 2.16 Watts in bright sunlight.

As with their larger units, this panel is based on an aluminium extrusion which acts as a heat-sink that gives rigidity. The cover is made of low-iron oxide, tempered glass. A Schottky diode is built in to prevent the battery discharging through the panel at night time.

This unit is ideal where only a small amount of power is required e.g.: electric cattle fences; where weight is a factor (they have been used in glider planes), or simply for experiments in schools, colleges and for hobbyists.



Sensor Technology is represented in Australia by Amtex Electronics, P.O. Box 285 Chatswood 2067. (02) 411-1323.

Briefs

Hitachi are making high-frequency NMOS power FETs featuring Molybdenum gates. This gives them one-tenth the resistance of their earlier polysilicon-gate power MOSFETs. Transconductance is substantially flat out to 30 MHz and amplifiers have been built with a 3 dB corner at 100 MHz, Hitachi claim. They don't suffer from current hogging and are especially suited to parallel operation at VHF. Complementary p-channel devices should be available by now, according to our source.

An enormous range of fascinating Exar products was released here in October by local distributors A.J.F. Systems & Components. The range includes a new bar graph gen. IC, the XR2276, to interface with flouro or LED displays; a family of ultra low noise op-amps for professional audio equipment; three programmable quad op-amps — XR094, XR095 and XR096 — featuring high input-Z and wide bandwidth; plus a second source for TI's-072/074 and TL-082/084 series BIFET op-amps. For full information, phone Tom Casey at A.J.F. on (03) 67-9702.

The Japanese Sharp Co. unveiled a colour TV in October featuring a "picture-within-a-picture" facility. The insert picture is stored within a 3712 element bucket brigade device, the same one as used in their black and white picture-within-a-picture TVs.

Sharp has also introduced an electronic translator/calculator which can store up to 5000 Japanese words and up to 2500 English words and 300 phrases. It sells in Japan for around $US180 and English, French and German models were due to be released last month. Designated the IQ-3000, the translator is built around four 12K CMOS ROMs and an 8-bit microprocessor. It has an LCD display capable of showing up to 16 letters, or figures to eight digits.

CSIRO is to establish a new research Division designed to provide a focus for the needs of Australian manufacturing industry. To be called the Division of Manufacturing Technology it is scheduled to commence on 1 July 1980 and will have scientists working in Adelaide, Melbourne and later Sydney, in close collaboration with industry. It will start up under the Division of Materials Science, hiving off on its own next year.

NEWS digest

NSW studies sites for wind power

There is a paucity of data throughout Australia on wind velocities and frequency of occurrence. Meteorology stations are not usually located in the windiest areas and they usually measure only mean wind speeds.

Since power from the wind is proportional to the cube of the wind velocity, power calculated from the mean wind speed can be in error by a factor of three.

Also, mean wind speeds can vary by a factor of two within a short distance of meteorology stations. This means that wind data from such stations is virtually useless for predicting wind power availability in particular areas.

The size of a windmill is very much dependent on the frequency and availability of the wind. If the wind blows regularly then a much smaller windmill is necessary than if intermittent wind is available. Also the number and hence cost of storage batteries is much reduced.

At the moment it is impossible to predict what size and type of wind energy system should be installed in a given area.

A year ago, Dick McCann and Tony Sweetnam of the Chemical Engineering Department commenced a wind power survey of New South Wales, funded by the Rural Credits Development Fund and the NSW Energy Authority.

They are developing a model which will enable reasonably accurate predictions of power to be made on the basis of a few easily determined parameters.

In the first part of the study, nine anemometer/solarimeter microprocessor systems are being set up in three regions of NSW. In addition to recording five minute wind speed averages they will also monitor solar insolation in order to develop a correlation between wind power and solar power.

Qualitative observations in NSW have shown that on days when the sun is not shining it is very often windy. This suggests that the combination of a wind turbine with a small photovoltaic array might result in a minimum cost system.

At the user end of the system, the way in which wind-energy electricity is used is also important. Electricity should only be used for lighting and household appliances — never for heating and cooking.

Direct solar energy and biogas can provide these latter requirements. Batteries too have an optimal user strategy; the life of a battery is dependent on the number of charge/discharge cycles and also the depth of discharge. Thus, by optimising user strategy the cost per kilowatt is reduced.

High value resistors

Philips have announced a new series of resistors featuring high resistance values, high voltage ratings, low noise, high stability, improved power characteristics and small size.

The VR25 series basically consist of a deposit of metal-glazed film on a high grade ceramic body with contact caps of special alloy pressed onto the ends of the resistor body with tinned electrolytic copper connecting wires welded to the caps. The resistors are coated with a light blue insulating lacquer for environmental protection. The series has a value range of 220 k to 10 M (E24), and 12 M to 15 M (E12), with a planned extension to 22 M.

Further information from Philips Electronic Components and Materials, P.O. Box 50, Lane Cove 2066.

Microprocessor 100 MHz oscilloscope

Versatile timing measurement capability and facilities for delay by time or event are combined in the PM 3263 microprocessor-equipped 100MHz oscilloscope from Philips.

The PM 3263 is a compact portable two-trace instrument providing dual-delay timebase, digital delay, direct frequency measurement and automatic TTL triggering.

A built-in LED display provides unambiguous readout of delay times, events and frequency. Other features include alternate display of main and delayed sweeps and a trigger view facility which can be used as a third display channel. Sensitivity of the instrument is 5 mV over the full bandwidth, with 2 mV up to 35 MHz.

Timing measurements include time intervals and frequency. Event counting is possible before delayed or main timebase starts. And event counting before the main timebase can be combined with the time interval or frequency measurements.

Indication of all time intervals and number of events is given on the built-in LED display with a separate indication of quantity — that is the number of events, number of divisions and seconds or Hz. Time and frequency are displayed in engineering notation.

Benefits claimed for the Philips system include storage of subsequent event and time settings, indication of faulty instructions and self test of the LED display. Also built in is a service monitor and a set of service routines for the microprocessor to simplify service and maintenance.

The use of the microprocessor also helps simplify the control layout — the only additional facilities needed are the six-digit LED display and a countup/count-down control. This last can be operated either slowly or quickly.

The new oscilloscope is based on Philips' successful PM 3262 model and has all the standard features of that instrument.

The PM 3263 operates from ac or dc — 90 to 140 and 180 to 260 Vac and 240 to 300 Vdc — or from an (optional) battery pack for field use.

NEW INSTRUMENTS from Christie Rand Pty. Ltd.

The SABTRONICS Type 8610 A Frequency Counter, gives you a first class, high stability Instrument at the hobbyists price, for an **8 digit counter. Frequency Range** guaranteed **10 Hz to 600 MHz** (typically 5 Hz to 750 MHz) with a good sensitivity which holds over the whole range. **Measurement accuracy** of 1ppm plus 1 digit or **0.0001** percent. **Ageing Rate:** plus/minus 5ppm/yr. **Gate Times,** 0.1, 1, 10 secs. Battery Operated (not with unit). Size only 8"x6.5"x3". Weight 0.54kg (less battery)

ONLY $289 incl S.T.
KIT $250 incl S.T.

SCOPEX from England offer — a new lightwelght dual trace, D.C. to 10 MHz oscilloscope with a 3 percent accuracy for the amplifiers and timebase. **The Scopex 4D-10B** is sold by Christie Rand Pty Ltd. Other features are: **Y Amplifiers** 10mV/cm to 50V/cm **Timebase speeds** 100ms/cm to 1us/cm **Times 5** magnifier. Alternative channel & Chop **Trigger** Normal/TV field (TV line on Normal). AC switch for Amp to 3Hz. Z Modulation.

ONLY $550
Plus 15 percent S.T.

A NEW 0.1 PERCENT DIGITAL MULTIMETER BY SABTRONICS, U.S.A. is now available in **KIT** form. The price is lower than other comparable DMMs on the market **The SABTRONICS model 2010A** is obtainable from **Christie Rand Pty Ltd.** The specification of this 3½ Digit multimeter is:- **D.C and A.C Volts 100uV to 1000V** from 0.1 percent accuracy DC & 0.5 percent A.C. **D.C and A.C Current 0.1uA to 10 Amp** from 0.1 accuracy DC & O.5 A.C. **Resistance 100mn to 20Mn** from 0.1 percent accuracy. **Diode Test 1mA, 10uA, 0.1uA** Temp Range OC — 55C. Dry cells not Included. Size only 8"x6.5"x3".

ONLY $159 incl S.T. KIT $142 incl S.T.

To compliment the dual trace oscilloscope by SCOPEX the D.C. to 25 MHz 4D-25 is now available. Again with all of the features listed in the 4D-10B including an **accuracy of 3 percent** for Amps and Timebase. **Timebase speed** 200ns/cm to 200ms/cm

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DC to 10MHz Oscilloscope

- 10mV to 50V/cm sensitivity.
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- 8 x 10cm display.
- 5% calibration.
- Ideal for use as an X-Y-Z monitor.
- Voltage measurements may be made to >25MHz (handbook supplied with response chart).

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	W. Arthur Fisher Ltd. Auckland. Phone 59 5527

NEWS digest

Hatched, matched, despatched

Brief news on company activities, new outlets, mergers, joint ventures and closures.

Hatched

• The firm formerly known to many enthusiasts as Kitsets struck the shoals a few years back and was subsequently taken over by an enterprising, hard working gent name of David Ryall. It then became known as D.R. Hi-Fi and Electronics. However, of recent, the name has been changed to Dave Ryall Electronics . . . and that's how it shall remain; fairies at the bottom of the Corporate Affairs Commission permitting.

In Sydney they're on the end of (02) 982-7500; in Brisbane (07) 52-8391. They carry a goodly range of components, plus kits, speakers and tools.

• For the benefit of NSW South Coast enthusiasts, Dick Smith has opened a store conveniently located at 263 Keira St, Woollongong. Peter Harding is the manager. Enthusiasts are invited to call in and browse or ring Peter (042) 28-3800 for specific inquiries.

Matched

• Sydney-based firm Associated Controls Pty Ltd recently announced their appointment as exclusive authorised distributor in Australia for the range of microwave diodes and transistors produced by the Nippon Electric Company (NEC) of Japan.

The NEC range of microwave devices is very wide, and in many cases, unique. The range includes microwave power GaAs FETs, RF power bipolar transistors, low-noise microwave bipolar transistors, Gunn and Shottky diodes and many other interesting devices.

Further information, catalogues etc, available from Associated Controls Pty Ltd in NSW at (02) 709-5700 and Victoria at (03) 561-2966.

Despatched

• Dick Smith has moved his headquarters. The old one was bursting at the seams. The ETI staff can vouch for that, for, on a tour of the old Artarmon HQ earlier this year it was definitely 'standing room only'. New HQ address is:
Cnr Lane Cove and Waterloo Rds, North Ryde NSW 2113,
(P.O. Box 321, North Ryde NSW 2113)
Phone: 888-3200; Telex: AA20036.

• We despatched the wrong phone number with H. Rowe & Co's advertisement on page 165 of the October issue. Amend your phone list to read (03) 329-6511 for their Melbourne phone number. Thank you.

Microwave Developments, makers of the HSK microwave demonstrater kits for schools and colleges (see ETI July, p.9.), are moving from Sydney to Adelaide. The new design and manufacturing facility will be located at 6 Netley Rd, Mount Barker SA 5251, (08) 388-1092. The facility will continue to be operated by Des Clift (VK2AHC) and wife Marjorie.

The NSW outlet will now be operated as part of T.J.H. Systems Installations under the direction of Trevor Harwood, from P.O. Box 148, Crows Nest NSW 2065, (02) 439-4658, TLX AA27802.

In addition, Trevor will take over the Microwave Associates business originally handled by Microwave Developments. These include the Gunnplexer range of 10 GHz transceivers.

Seven-segment displays by Beckman

Three new gas-discharge displays and three new liquid crystal displays, from US manufacturer Beckman, were released here recently through Warburton Franki.

Biggest and brightest of the bunch is the SP-491, a six-digit, 18 mm character-size display featuring flat screened image construction that provides a wide (130 degree) viewing angle that is easy to read, even in direct sunlight due to the neon-orange display, say Beckman. It is designed for multiplexed operation and Motorola's 8-segment buffer-driver, MC3492, is suitable as a cathode driver, the eighth output of which can be used to drive the display's comma or decimal point.

Next in the line-up are the HB-330 and HB-350 series of planar gas-discharge displays. The first features 8.4 mm high characters that can be viewed up to six metres away while the latter features 14 mm high characters that can be viewed at distances up to 12 m away, according to Beckman.

Displays containing from two to four digits are available in the two lines. Both series feature slim line construction and low power consumption. Colour is neon orange and viewing angle is 130 degrees. A keep-alive cathode within individual display envelopes reduces reionisation time to less than 30 microseconds allowing zero suppression and improving low temperature operation.

The three liquid crystal displays, 737-01, 739-03 and 739-04, are available in transmissive, reflective and transflective modes, require between three and 20 V RMS at less than eight microamps drive current and in typical portable, battery-operated instruments, batteries will last up to three years due to the display's minute power consumption.

For further information, contact Warburton Franki; they have branches in Adelaide, Brisbane, Hobart, Melbourne, Perth and Sydney.

Kit builder's guide

Recently to hand from Jostykit importers, Vicom, was an excellent little manual for electronic project builders.

Although intended for use with their kits, the manual is very useful as a general guide to electronic constructors. It is well illustrated, in full colour, with a clear, easily-read text.

The topics covered include: component mounting, soldering (very well done), resistors and resistor colour codes, pots, capacitors, semiconductors, coils and transformers, plugs and switches, chassis mounting and sources of faults.

You can obtain one by writing to Vicom, enclosing a stamped, self-addressed envelope. Vicom are at 68 Eastern Rd, South Melbourne Vic 3205.

DMM for $70!

Prices have fallen so rapidly on digital multimeters recently that analogue types are striking some stiff competition.

Ampec Engineering recently released an inexpensive hand held DMM, manufactured by the SOAR Corporation, priced to sell here at around $70.

Designated the ME-501, the unit features five current ranges from 200 microamps to 10 A, five dc voltage ranges from 200 mV to 1 kV, two ac voltage ranges of 200 V and 1 kV, four resistance ranges from 2k to 2M plus a diode test and transistor hfe checker.

The ME-501 features an LCD display, battery operation and four digit readout. More information from Ampec Engineering, 1 Wellington St, Rozelle 2039 NSW. (02) 818-1166.

"Resolution of the 4·43MHz sub-carrier was better on the TRIO CS1560A scope..." says Ian West, National Service Manager, Toshiba Australia.

Ian West is responsible for all Toshiba service within Australia. This includes three service divisions and liaison with over 500 service agents. We asked him why he chose the Trio CS1560 scope for service use.

"We found that for TV., audio and VCR servicing, the Trio has a brighter display on H.F. signals. The Resolution of the 4.43 MHz subcarrier is better due to the scopes' 15MHz bandwidth.

"Also my job involves training other technicians, so we were looking for a scope that's easy to drive. The 1560 has proved ideal for setting up VCRs. Using its chop facility we can easily compare counted down signals with the original.

"We are using quite a few Trio instruments. They offer excellent value with just the right extra features that we need."

Check the full Trio range from . . .

CS 1560 15MHz, 10mV, Dual Trace.

TRIO

- 130mm CRT
- DC-15MHz/10mV
- Automatic sweep (AUTO FREE RUN)
- Display modes (CH1 CH2 DUAL ADD SUB)
- Full sensitivity X-Y operation

• SPECIFICATIONS

Bandwidth	DC to 15MHz (−3dB)
Deflection factor	10mV/div to 20V/div
Input R.C.	1MΩ, 22pF
Risetime	23nsec
Overshoot	Better than 3%
Sweep time	0.5μs/div to 0.5s/div
Magnifier	x 5
Linearity	Better than 3%
Calibrator	1Vpp (1kHz square wave)
Intensity modulation	More than 20Vpp
Phosphor	P31
Power	AC 100/120/220/240V. 50/60Hz, 23W
Dimensions	W260 x H190 x D385 (mm)
Weight	8.4kg

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PM98

Quality Test Instruments at Affordable Prices

TTM303 15MHz Mains/Battery operated oscilloscope

$598 EX. TAX
$687.70 INC. TAX
FROM STOCK

BRIEF SPECIFICATIONS:

The TTM Dual Trace Portable Scope Model 303 offers a high sensitivity of 5mV/DIV with DC to 15MHz bandwidth. The 3-inch CRT with 1.5kV regulated accelerating voltage gives a clear bright display.

This Portable Scope operates from standard line voltage (240V) or from the internal rechargeable Ni-Cad battery, that provides 2 hrs operation before recharging is required. It also operates from any external DC voltages of 11 to 30V, eg car batteries, standard "C" size cells, etc.

SENSITIVITY:— 5mV to 10V/DIV 1-2-5 step with fine control. BANDWIDTH:— DC: DC to 15MHz (-3dB). RISETIME:— 24ns. OPERATING MODES:— CH-A, CH-B and Dual Trace TIME BASE:— 1 usec to 500 mS/DIV with fine control. EXPANSION:— x 5 at all ranges. X-Y OPERATION:— X-Y mode is selected by SWEEP TIME/DIV switch. CH-A: Y axiz. CH-B: X axis. POWER REQUIREMENTS:— AC: 115/240V DC: 11-30V, 7.2VA. Battery: Ni-Cad Battery (up to 2 hour operation). SIZE: 113 (H) x 223 (W) x 298 (D) mm approx. WEIGHT:— 4.5kg.

Application BS610 15MHz No Parallax display oscilloscope

$625 EX. TAX
$718.75 INC. TAX

BRIEF SPECIFICATIONS:

The BS-610 employs a high brightness 140mm Rectangular CRT with internal graticule assuring easy and accurate observation of waveforms without any parallax.

External DC-Powered operation expands the versatility of this oscilloscope to FLOATING Measurements as well as field operation.

Other features including TV SYNC and HF REJ. make this scope ideal for research and development, production lines or in-the-field service applications from computers to electrical appliances.

SENSITIVITY:— 5mV to 10V/DIV on 11 ranges in 1-2-5 step with fine control. BANDWIDTH:— DC: DC to 15MHz (-3dB). RISETIME:— 24nS. OPERATING MODES: CH-A, CH-B, DUAL, ADD and CHOP. TIME BASE:— 0.5usec to 0.5sec/DIV in 19 ranges and X-Y in 1-2-5 step with fine control. MAGNIFIER:— x5 at all ranges. X-Y OPERATION:— X-Y mode is selected by SWEEP TIME/DIV switch. CH-A: Y axis. CH-B: X axis. POWER REQUIREMENTS:— AC: 115/240V DC: 11 — 30V, 7.2VA. SIZE:— 145 (H) x 280 (W) x 369 (D) mm. WEIGHT:— 6.7kg.

SP100 probes 100MHz, 10:1, 1:1, off posn. To suit TTM303 and BS610

$30 EX. TAX
$34.50 INC. TAX

FROM STOCK

FLUKE®

8020A 7 Function, 29 Range Hand Held DMM. Has unequalled capabilities

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Designed for the widest possible range of applications, the 8020A offers every one of the important functions and features in demand today by DMM users, and more. Measurement performance is fully specified and clearly stated for every parameter, and conservative Fluke design means you get instrument specifications you can depend on. Low cost of ownership, worldwide Fluke service and a complete range of measurement accessories make the 8020A ideal for use by anyone engaged in trouble-shooting or servicing electrical and electronic equipment.

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BRIEF SPECIFICATIONS:
10 VOLTAGE RANGES: 100uV to 1000 Vdc, 750 Vac.
Basic DCV Accuracy: +0.1% Basic ACV Accuracy: +075%
6 RESISTANCE RANGES: 100m to 20M Basic Accuracy: +0.1%
3 DIODE TEST RANGES: 2k , 200k 20M
2 CONDUCTANCE RANGES: Measure leakage from 500 to10,000M Measure beta.
8 CURRENT RANGES: 1uA to 200mA Basic DC Current Accuracy: +0.75% Basic AC Current Accuracy: +1.5%

STOP PRESS! **We now have in stock The Fluke 8022A DMM. Similar to the 8020A but slightly less accurate and without the conductance ranges. $144 Ex Tax. $165.60 Inc. Tax.**

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Phone (07) 229 3161

The ubiquitous oscilloscope

There's no substitute for 'looking inside' a circuit when you really want to know what's going on. The oscilloscope must surely be the most versatile electronic instrument ever invented. Les Bell and Roger Harrison take you on a guided tour, from how they work to how to buy to who supplies them.

ONE OF THE BIGGEST barriers people face when they take up electronics is cultivating the ability to visualise what is happening in a circuit. It is fairly easy to work out the dc conditions in a circuit, but electronic circuits are generally dynamic in nature; that is, the voltages and currents in a circuit change according to an applied signal or function of the particular circuit (as in amplifiers and oscillators, respectively).

The problem is, you can't *see* what's happening! The "good books" may tell you what happens *ideally*, but the real world is very often quite different.

What's needed is some kind of 'window' into the circuit, to enable you to 'see' what's happening, to get that intuitive 'feel' which will make understanding that much easier. That window is, of course, the oscilloscope. Without it, the circuit designer may very well be 'blinded'.

Oscilloscope basics

The heart of a Cathode Ray Oscilloscope, or CRO as they are more commonly called, is the *cathode ray tube*. Its construction and basic operation are explained in the accompanying box. There are two basic types of cathode ray tube – those employing electrostatic deflection and those employing magnetic deflection.

Electrostatic deflection types are commonly employed in measuring instruments as they offer much greater bandwidth operation than magnetic deflection tubes which are principally limited by yoke inductance. On the other hand, electrostatic deflection tubes are limited to beam deflection angles less than 20° off axis while electromagnetic systems can achieve a maximum deflection of ±55°. This is why oscilloscope tubes (electrostatic types) are so much slimmer than TV tubes (which use magnetic deflection) of similar length.

Some demonstration and teaching oscillopes use standard TV tubes with magnetic deflection. Whilst the display is massively larger than a standard oscilloscope, the bandwidth limitations only allow them to display signals generally less than 100 kHz maximum. Oscilloscopes using electrostatic Cr tubes may have bandwidths of 10 MHz commonly, and up to 100 MHz without using special techniques.

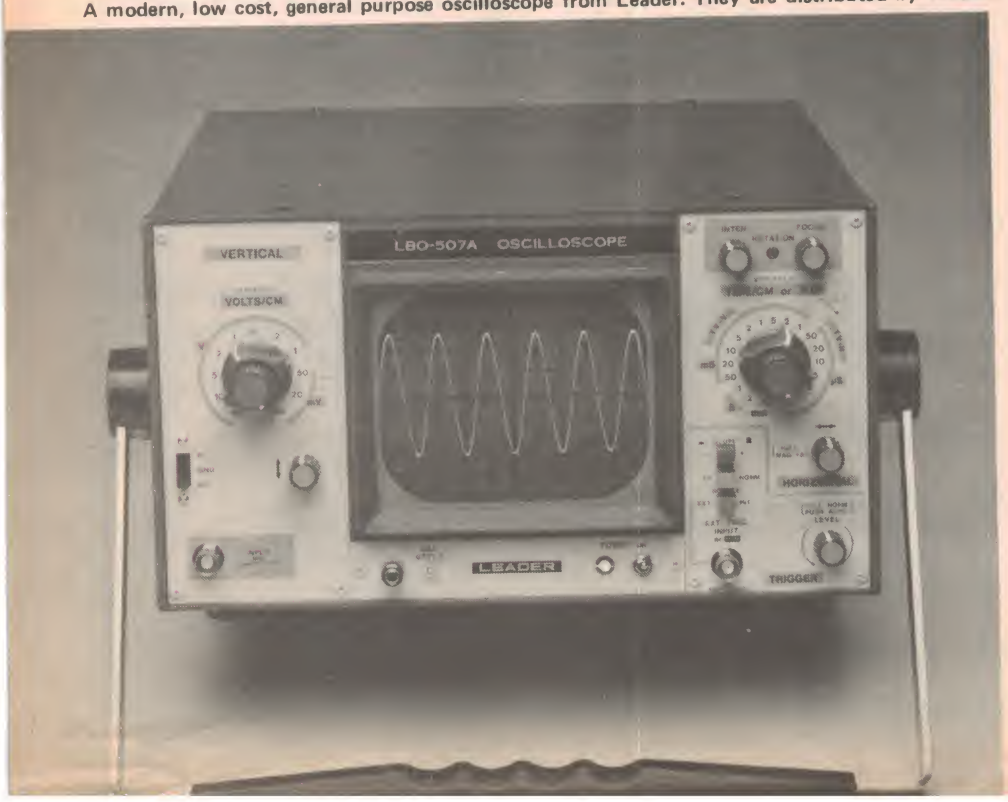
The general purpose of an oscilloscope is to examine voltages (or sometimes, currents) as they change with time. There are other modes of operation, but as this is the fundamental one, let's start with it.

In order to display a waveform that is varying with time, we must draw the 'spot' across the face of the tube, from left to right, return to the starting point and repeat. To do this, the voltage impressed on the X deflection plates is increased at a linear rate with time, to draw the spot from left to right, then reduced to zero (or the starting voltage) suddenly to return the spot to the starting point, and so on.

This establishes a 'time base' as the spot takes a known amount of time to travel from left to right across the screen.

At the same time, the waveform to be examined (suitably amplified) is applied to the Y deflection plates. The spot will then trace out a graph of the waveform on the CR tube screen as shown in Figure 1.

A modern, low cost, general purpose oscilloscope from Leader. They are distributed by Vicom.



If the time taken for the spot to travel across the screen has a definite relationship to the frequency of the waveform being examined, and if the start of the trace (at the left hand side) is arranged to commence at some definite point on the waveform (i.e. synchronised), then a stable trace will result on the screen.

For example, say we wish to display two cycles of a 50 Hz mains voltage. The horizontal deflection, or timebase, would have to 'sweep' the spot from left to right in the length of time it takes to complete two cycles at 50 Hz — 40 milliseconds. The timebase would make 25 sweeps per second: that is, it would be running at 25 Hz.

In a practical oscilloscope, during the 'return' sweep of the X deflection (sometimes termed the 'flyback'), the electron beam of the CR tube is turned off, or 'blanked', so that it is not displayed — otherwise, the resultant squiggle would become confused with the desired display!

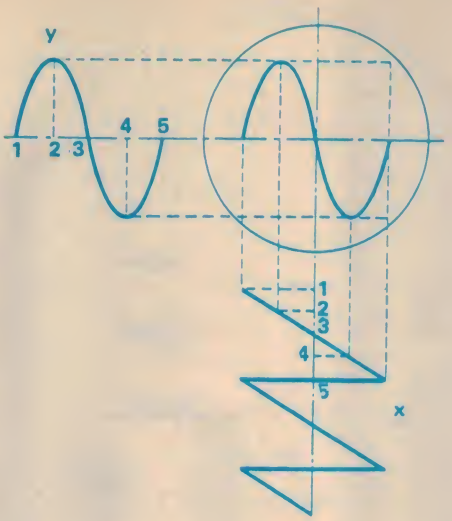
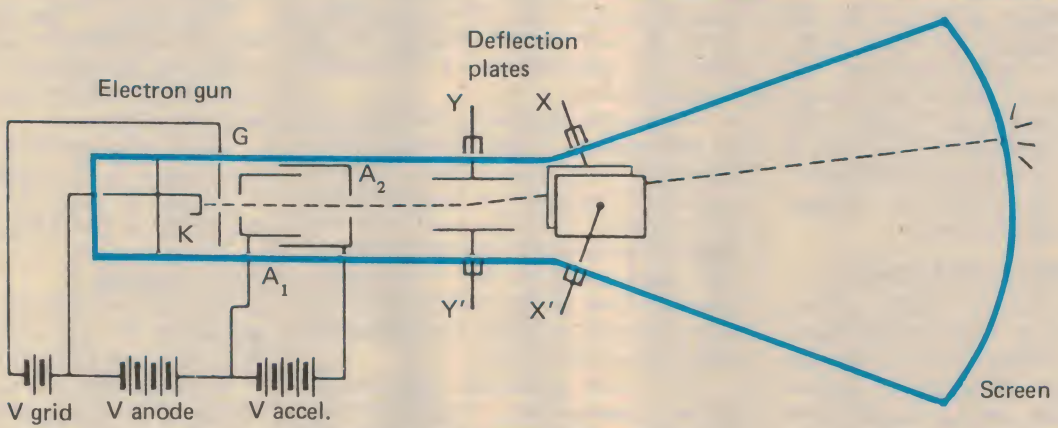


Figure 1. **Showing how the deflection waveforms applied to the X and Y plates of a cathode ray tube cause the electron beam spot to trace out a faithful replica of the Y-input waveform.**

The signal applied to the X deflection plates of the CR tube is often referred to as the 'sweep' voltage, or just 'the sweep', although the term 'timebase' is generally more common.

Oscilloscope manufacturers include a 'graticule' on the screen of their instruments as a convenient reference, enabling quite accurate time an amplitude measurements to be made. The graticule may be a transparent plastic cover placed over the CR tube face, scored with grid lines at convenient intervals (generally 10 mm) or, as in the more expensive types, it may be scored directly on the face of the CR tube during manufacture. The latter provides a more accurate reference than having a separate, external, graticule.

The general form of most general-purpose oscilloscopes is shown in Figure 2. As you can see, there are four basic components: the Cathode Ray Tube, the Vertical Circuits, the Horizontal Timebase Circuits and the Power Supplies. ▶



The cathode ray tube

The component at the heart of the oscilloscope is the cathode ray tube. It consists of an evacuated, tubular glass envelope, flared at one end. In the tubular portion, or the neck, is an "electron gun". This generates a narrow, focussed beam of fast-moving electrons which are directed towards the flared end, past a set of parallel plates (the deflection plates), the large end of the tube being covered in a special coating (on the *inside*) called the 'phosphor'. When the electrons strike the phosphor, it emits light ('fluoresces') and you see a spot. Spot deflection is achieved by varying the electrostatic field between the deflection plates. Some CRTs use electromagnetic coils around the neck of the tube for spot deflection (TV tubes for example!)

The electron gun contains a *heated cathode* (K) which 'boils' off electrons. These are attracted to an *anode* (A1) which is very much more positive than the cathode, at least several thousand volts. As they accelerate towards the anode, the electrons pass through a *control grid* (G) which is a cap of metal around the cathode and somewhat negative with respect to it. This electrode is used to control the brightness of the spot. If the negative potential on G (with respect to K) is increased, fewer electrons will pass and the spot brightness will decrease, and vice-versa.

Between the control grid and the focussing grid there may be a second grid, the *screen grid,* which is usually around 300 V positive. Following the *focussing anode* (A1) there is usually a *second anode* (A2). Voltage on the final anode is very high — usually several kV. Alternatively, between the control grid and the second anode, there may be an *Accelerator* electrode (sometimes called a "pre-accelerator") at the full final anode voltage. This arrangement constitutes a focussing scheme called an 'einzel lens'. Varying the potential between K and A1 will vary the spot size. This is used to focus the spot.

The electron beam passes between the plates, in order to be deflected, but after the first set of plates the beam can be anywhere in quite a large area. This means that the second set of plates must be larger, with an associated increase in capacitance. Usually, the vertical deflection plates come first, since the Y channels require greater bandwidth, while the X channel or timebase requires a lower bandwidth.

The result of all this acceleration and focussing is a well-focussed, high-energy beam of electrons travelling straight down the centre of the tube. In order to deflect the electron beam and create a display, a pair of electrostatic deflection plates are provided for each axis (X and Y). An electric field will deflect the electron beam, providing spot movement over the face of the tube.

Following the deflection electrodes, many electrostatic CRTs have a *post-deflection accelerator* which usually takes the form of a graphite spiral around the envelope funnel between the neck and the face of the tube.

The use of electrostatic deflection is necessary because it offers a wider bandwidth than electromagnetic deflection systems which are limited (principally) by yoke inductance. Electrostatic deflection requires much longer tubes for a given screen size as beam defocussing limits deflection angles to less than 20° off axis, while electromagnetic systems can deflect up to ±55°.

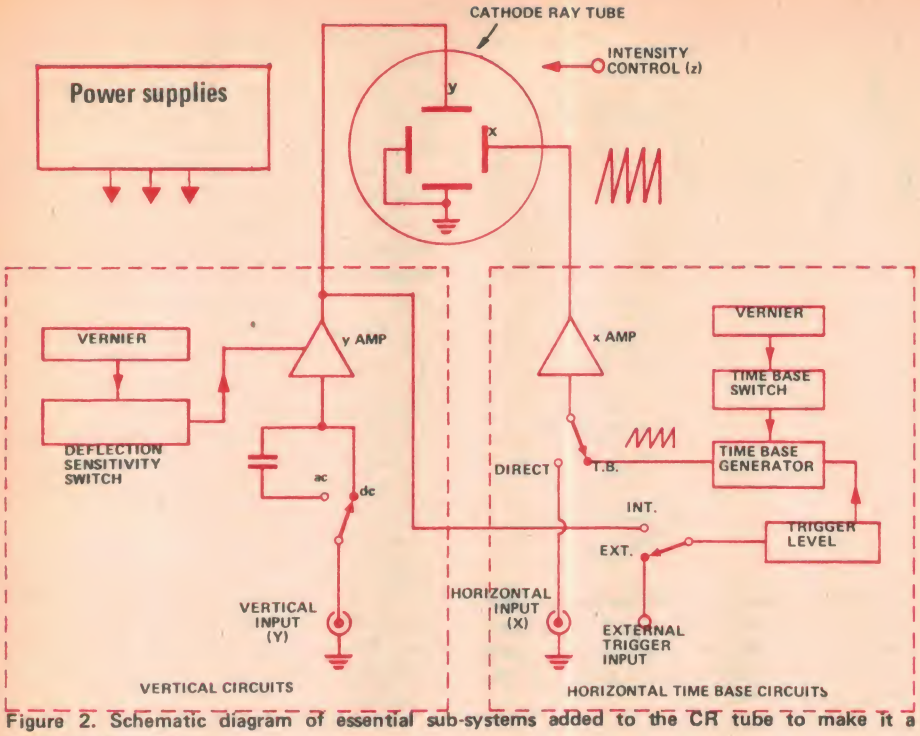


Figure 2. Schematic diagram of essential sub-systems added to the CR tube to make it a measuring instrument.

We have already spoken of the CR tube in some detail, so that's out of the way. The power supplies provide the various anode, grid, screen and accelerator voltages (plus heater) for the CRT and supply rail voltages for the vertical and horizontal circuits. Straightforward.

Now that's out of the way, let's get down to the interesting bits.

The timebase and X amp

So that waveforms of widely varying frequencies can be displayed the timebase must be variable over a very wide frequency range. Accordingly, oscilloscopes are made having the timebase 'range' switched at convenient increments. The actual ranges included on an instrument depend on the applications for which it is intended, but typically the minimum sweep rate may be 20 seconds for a full sweep (generally 2 s/division) ranging up to a maximum of one microsecond for a full sweep (0.1 us/division. The range steps generally go in intervals of 5,2, 1. A vernier control is always provided so that a display may be varied for some convenient purpose.

The timebase generator provides a 'sawtooth' waveform (as that's what it resembles) for the X deflection. This is amplified and applied to the X plates of the CRT. The 'width' of the timebase deflection on the CRT face depends on the amplitude of the sweep waveform. Thus, a *width* control may be provided by having a potentiometer to control the gain of the X amp. A dc voltage, or bias, applied to the X plates will determine the horizontal *position* of the trace on the CRT face. Thus, a potentiometer to vary the dc bias on the X plates is provided as a *horizontal position* control.

So that the timebase generator may be synchronised to the waveform being examined (to provide a stable trace as explained previously), a 'trigger' circuit is included. The timebase may be triggered internally by sampling some of the signal going to the Y deflection plates or from an external signal. This is very convenient in particular applications which are explained later.

For some particular applications (phase measurement, frequency comparison) a sawtooth sweep is undesirable for X deflection, so direct access to the X amp is required. For this purpose the input to the X amp can be switched to a front panel socket, generally marked *horizontal input* or an abbrevation of same.

The vertical or Y amp

The signals one may wish to examine might range from microvolts to hundreds of volts! The lower level signals will require amplification (as the deflection voltages required may be tens to hundreds of volts), the higher level signals will require attentuation. Accordingly, a *sensitivity* switch is provided ahead of a high gain, low distortion amplifier – the Y amplifier.

The most sensitive range of common oscillopes is typically 5 mV to 10 mV per centimetre (one graticule division). More expensive types may have a maximum sensitivity as high as 10 uV/cm. The insensitive end of the range will generally be around 50 V/cm for run-of-the-mill CROs but special instruments (eg: those used for electrical supply applications) provide for levels as much as ten times higher. As with the timebase range control, sensitivity steps are generally in 5, 2, 1 intervals.

A *vernier* sensitivity control is provided for convenience.

The bandwidth of the Y amp is an important factor in the selection and application of an oscilloscope. A general purpose instrument may have a bandwidth extending from dc to 10 MHz or 15 Mhz. Inexpensive units may only extend to 3 MHz. Magnetic deflection units (generally for demonstration or teaching applications) may only reach 20-50 kHz, few struggle as high as 100 kHz.

High quality instruments ($$$$!) may have bandwidths as great as 350 MHZ. Special instruments, using 'sampling' techniques, may reach 1 GHz (1000 MHz!).

To examine ac waveforms superimposed on a dc voltage, the Y amp must be ac-coupled. Accordingly, a switch is provided that inserts a capacitor in series with the input.

The range of the input sensitivity may be extended by the use of *probes* which can provide such facilities as very high voltage attentuation and increased input impedance.

The *vertical position* of the trace is determined by a dc bias applied to the Y plates of the CRT, in the same manner as for the X plates.

The Z input

If 'Y' represents the vertical axis and 'X' represents the horizontal (time) axis, then what on Earth is the 'Z' axis?

The only thing left to vary on a CRT display, after moving the spot vertically and horizontally, is the intensity of the spot. Accordingly, most CROs will include a *Z input*. In general this allows for *blanking* and brightening of the display or for making particular types of measurements.

That completes the description of your 'basic' oscilloscope (. . . . therein lies the lesson for the day, as the preacher said).

Dual-trace operation

It is often helpful to be able to display two waveforms at the same time – for example, to measure the phase change on a signal passing through an amplifier stage. This can be achieved in two different ways.

One can simply build two completely separate guns and two sets of deflection plates into a single CRT envelope. These dual-beam CRTs are complex and expensive, and they require two completely separate sets of drive amplifiers – more expense. ▶

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The alternative, used in most modern dual-beam scopes, is 'dual-trace' operation, in which a single-beam tube is used to display two traces by switching between them. Two methods of beam-switching are used; one can either switch between traces at the end of each sweep, which is suitable for high-frequency waveforms, or at lower frequencies one can switch alternately between the waveforms as the sweep progresses across the display.

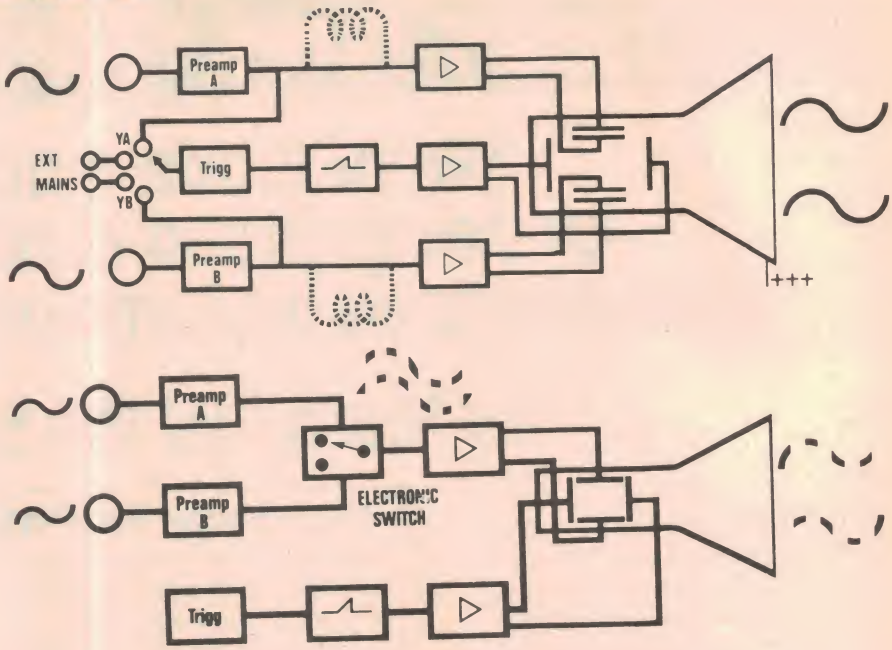
The first method is called *alternate trace*, the second is *chopped trace* operation.

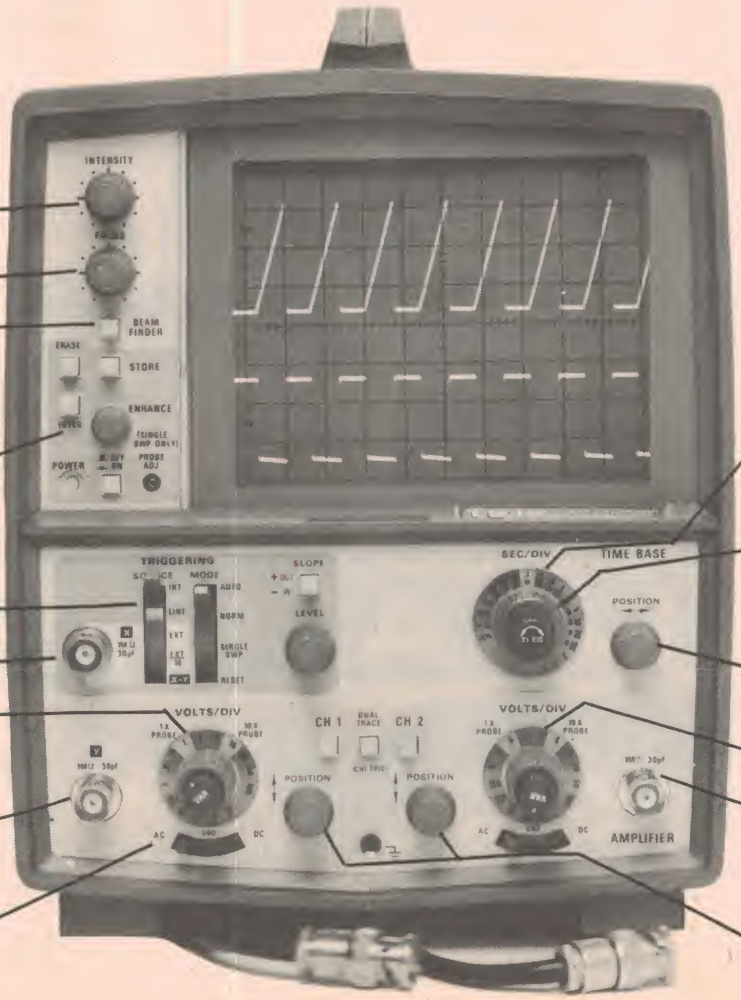
These basic principles apply to all oscilloscopes, except some types which are intended for specialised applications. Of course, oscilloscopes are more complex than this in practice, and perhaps the best way to see some of the more sophisticated facilities is through the controls on the front panel of an oscilloscope of medium complexity.

Choosing (not using) a scope

There comes a time in every young man's life when he can't figure out what

Dual-trace oscilloscopes can be implemented in two ways: using a *dual beam* cathode ray tube or using a single beam tube and *electronic switching* of the trace. The block diagram at the top is of a Philips model 3232 and is typical of dual-beam types. The block diagram at the bottom shows the electronic switching technique of obtaining dual-trace operation with a single beam cathode ray tube.





A modern dual-trace oscilloscope with trace storage facilities, the Tektronix model T912. The operation of the controls is explained in the notes here.

INTENSITY
To adjust trace brightness

FOCUS
What it says

BEAM FINDER
Returns trace to screen when excessive deflection present.

STORAGE FUNCTION CONTROLS

TRIGGERING
To synchronise the trace under differing circumstances.

X-INPUT

INPUT ATTENUATOR
To adjust amplitude of vertical deflection (variable control in centre).

CHANNEL 1, Y-INPUT

AC/DC COUPLING
To allow measurement of dc and ac waveform amplitudes.

TIMEBASE RANGE SWITCH
To select sweep speed in convenient increments.

SWEEP EXPANSION
Variable control allows expansion of trace by up to 10 X (not calibrated).

HORIZONTAL POSITION
To move trace left or right to aid time measurement from the graticule.

INPUT ATTENUATOR
(See other channel).

CHANNEL 2, Y-INPUT

VERTICAL POSITION
To move trace up and down for amplitude measurement off graticule.

on earth that circuit's doing, and then he decides to buy an oscilloscope. Of course everyone has different requirements – digital circuitry, RF, high fidelity, process control, computer equipment – these applications all have widely varying characteristics – so what should one look for when evaluating the performance of a CRO?

The most obvious consideration is bandwidth. The bandwidth of a general purpose oscilloscope is the frequency at which the total gain of the oscilloscope is 3 dB down on its mid-band performance. There are several limitations on the bandwidth of an oscilloscope, ranging from the bandwidth of the amplifier stages themselves to the time which the electron beam takes to pass between the deflection plates and the amount of energy required to make the phosphor glow. For example, if the input waveform goes through a complete cycle during the time that an electron is passing between the plates, then the deflections will average out, giving a net deflection of zero!

In the dc mode, there is no problem with low frequencies right down to dc, particularly when using long-persistence phosphors. The bandwidth figure given in specifications is therefore the upper frequency limit of the scope.

Closely related to bandwidth is the risetime of the scope. This is the time taken for an input square (really square) wave edge to go from 10% to 90% of its value on the screen. Unfortunately, on high performance CROs, this is well-nigh impossible to measure, and it is usually calculated from the bandwidth instead , using the formula:

$tr = 0.35/BW.$

The vertical amplifier system of a scope should ideally have a risetime five or more times faster than the risetime of the fastest signal it is intended to examine. In this case, risetimes measured on the scope will have less than 2% error.

It is generally important to get the highest bandwidth and fastest risetime your money will allow. When examining a square wave signal, for example, Fourier analysis tells us that the square wave is actually composed of a series of harmonics of the fundamental frequency.

If the vertical amplifier and tube of a scope lop off the fifth and higher harmonics, the square wave will be noticeably rounded. In this case, risetime measurements will be virtually meaningless.

Glitches in digital circuitry will virtually disappear on a narrow bandwidth CRO, rendering it well nigh useless for digital troubleshooting. Thus, although you may be working with quite slow logic, a high speed scope is still very useful. For a typical hobbyist, with no specific requirements or interests, a 15 MHz oscilloscope would probably be ideal.

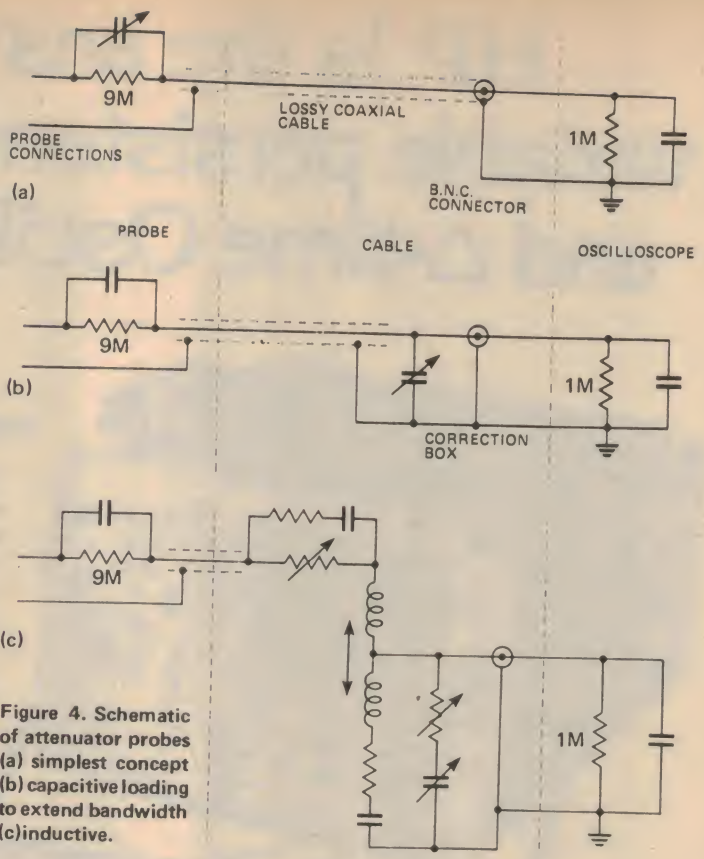


Figure 4. Schematic of attenuator probes (a) simplest concept (b) capacitive loading to extend bandwidth (c) inductive.

Probes

A point to watch for, particularly with high frequency scopes, is the selection of suitable probes. The capacitance of the probe leads can severely limit the bandwidth of an instrument so it is essential to use the appropriate probes.

Most oscilloscopes have an input resistance of 1 M ohm, and x1 probes will give this resistance at the probe tip plus a capacitance which is in parallel with the scope input capacitance (usually around 20-30pF).

For higher input resistance, x10 probes are available which include a 9 M ohm resistor, thus raising the input resistance to 10 M ohm.

Probes require compensation for capacitive effects which limit their bandwidth. For very wide bandwidth operation, complex compensation network may be used. Typical probe circuits are illustrated in Figure 4.

Sensitivity and accuracy

The sensitivity of an oscilloscope is usually expressed in mV/cm or mV/div, and in general, a higher sensitivity scope is more useful than an insensitive one.

Accuracy, in the absolute sense, is probably less important than with other pieces of test equipment, as an oscilloscope is generally used for qualitative analysis. Most oscilloscopes have an accuracy of ±5%, but as one moves into laboratory, as opposed to service/general purpose machines, ±3% accuracy is more common. It is tempting to suppose that by buying a more accurate oscilloscope, one could save money on other test equipment but, this is not the case. Modern digital test equipment is now quite cheap, while accurate oscilloscopes are not, even leaving aside the inconvenience of making measurements by counting divisions on the graticule.

Other facilities

In deciding on an oscilloscope, several other factors ought to be taken into consideration. The obvious question is: will I need a dual-trace scope? There is very little to be said about this choice; you pays your money (as much as you can afford) and you takes your choice. Single-trace scopes are becoming quite rare beasties, in fact, as dual-trace types are considerably more versatile.

The triggering facilities of a prospective purchase should also be carefully examined. It's probably true to say that poor triggering on a scope can render it the greatest bugbear of the user's life – virtually useless, in fact.

Unfortunately, there is no universal way to specify the triggering performance of an oscilloscope. It is best to ▶

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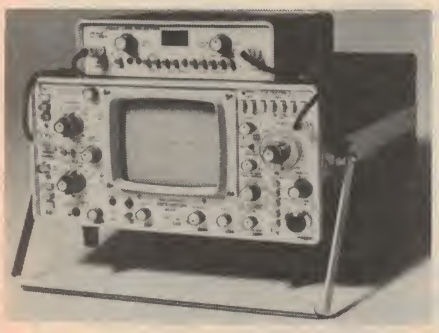
arrange a demonstration, either by the dealer or by an associate or friend who already has the oscilloscope in question. In any case, it is generally wise to ask around for other users' impressions when considering such a major purchase.

A useful facility on some oscillopes is the provision of two timebases with delayed sweep facility. In this mode of operation, for the first timebase, the delaying sweep is triggered by the trigger circuitry, and continues for selected delay time. When this time is reached, the second timebase takes over (usually at a higher speed), providing accurate resolution of an event which can occur some time after the trigger event. Incidentally, this is how we shot the cover photograph of the December 1978 issue of ETI.

Suppliers and brief product descriptions



BWD ELECTRONICS PTY LTD, Miles St, Mulgrave, VIC 3170. (03) 561 2888. BWD is a major Australian manufacturer of test equipment, including signal generators, power supplies, and of course, oscilloscopes. A range of models are available: the 540 is a dual channel 100 MHz lab scope with sensitivity down to 1 mV/div. The 539D is a 25 MHz dual trace general purpose oscilloscope. If you only require single trace operation, the 506 (15 MHz) or the 509B (10 MHz) may be suitable.

BWD also produce a plug-in scope, the 525, with a matching range of plug-ins, and a large screen oscilloscope, the 1722, also with a range of plug-ins, which is suitable for classroom demonstration use.

THE DINDIMA GROUP PTY LTD, P.O. Box 106, Vermont, Vic 3133. (03) 873-4455. These people handle the **Ballantine** range of instruments including a range of single- and dual-trace CROs in both portable and bench models.

Latest in the range is the "Series 1020" miniscopes available in single- and dual-trace models. Both are available in the same 203 mm wide by 187 mm deep by 83 mm high package weighing about 11 kg. The Series 1020 provides sweep rates from 100 ns/div to 100 ms/div in 12 calibrated steps plus a continuously variable x10 magnifier and a vertical bandwidth of 12 MHz. The 1020 operates from 12 Vdc which may be obtained from a battery pack (it draws less than 10 W) or external dc supply, or optional ac power converters (plug-in) for 120 V or 240 V, 50 Hz to 400 Hz mains. The screen area on both models is 50 mm x 40 mm (w x h) with a 5 mm/div graticule on the CRT face.

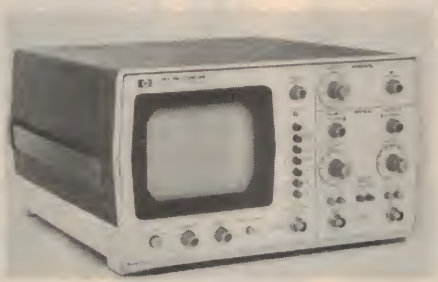
The case is fully sealed, there being no ventilating ports, and the unit is specified to operate over a temperature range of zero to +50°C. The Series 1020 scopes may be hung from a strap around the operator's neck in complete safety in cramped quarters as no mains voltages enter the equipment.

EAI-ELECTRONIC ASSOCIATES PTY LTD, 48 Atchison St, St Leonards, NSW 2065. (02) 439 7522. EAI manufacture a 300 mm slow-scan oscilloscope with a P7 phosphor. The major application of this unit is with EAI's analogue and hybrid computers, but it also has medical, scientific and engineering applications.

ELMEASCO INSTRUMENTS PTY LTD, PO Box 30, Concord, NSW 2137 (02) 736 2888. Elmeasco are agents for the British manufacturer **Gould Advance** whose product line includes 15 MHz dual-trace, 15 MHz dual-beam, 20 MHz, 25 MHz, 30 MHz, 40 MHz and 60 MHz dual-trace oscilloscopes with sensitivities down to 2 mV/cm. Delayed timebase is available on several models. Of special interest is the OS3350B, which is a BBC-designed unit, especially for TV signal examination, which can display a TV picture. Also available are the OS4000 and OS4100 digital storage oscilloscopes

Elmeasco also handle **Application Inc's** BS610 15 MHz dual-trace and BS310S 15 MHz dual-trace portable oscilloscopes. The BS310S features 2 mV/div sensitivity in a very compact unit. The **TTM Electronics** Model 303 is a competitive priced unit with internal NiCad battery, and 5 mV/div, 15 MHz performance. Lastly, the **Norland** 3001 is a very high performance digital scope with extremely advanced features way beyond the scope of this article.

JOHN HADLAND (AUST) PTY LTD, 7 Hampshire Rd, Glen Waverley, VIC 3150. (03) 560 2366. An unusual scope is available from John Hadland, agents for **Ealing Beck Ltd** of Watford England. This modular oscilloscope is designed for the classroom, teaching the principles of cathode rays, electrostatic and electromagnetic deflection and the operation of oscilloscopes. The kit consists of a CRT unit, around which can be placed deflection coils etc, a power supply, a CRT amplifier and time base. Instruction sheets provide several interesting experiments.



HEWLETT-PACKARD AUSTRALIA PTY LTD, 31-41 Joseph St, Blackburn, VIC 3130. (03) 89 6351. Hewlett-Packard is generally known as the 'Rolls-Royce of test equipment', but whether they hold that title in the field of oscilloscopes, considering the stiff competition from Tektronix, is a matter some would debate. Their oscilloscopes certainly are nice however, whichever camp you follow. The general top-of-the-line is the 180 series of plug-in scopes, which have vertical amps to 18 GHz (sampling) and sensitivities to 100μV.

In the more conventional portable range, the 1740A, 1742A and 1743A are 100 MHz dual-trace units, the 1715A is a 200 MHz unit and the 1725A and 1722B are 275 MHz types. The 1722B incorporates a microprocessor to calculate time delays, frequency, period, voltage and percentage difference measurements.

HP also have a range of storage oscilloscopes with variable persistence facility.

For less exacting applications, the 1220A and 1222A are a pair of 15 MHz dual-trace, 2 mV sensitivity general purpose scopes. The 1222A has a delay line, which allows examination of the leading edge of a waveform.

PARAMETERS PTY LTD, 68 Alexander St, Crows Nest, NSW 2065. (02) 439 3288. They handle **Trio** oscilloscopes which are among the most popular general-purpose and service types. Currently the most popular in the range is the CS-1560AII, a 15 MHz dual-trace model with easy TV sync triggering facilities. It has a sensitivity range of 10 mV/div to 20 V/div.

Also in the Trio range are: the CS-1570A, a 30 MHz, dual-trace, 5 mV/div model; the CS-1572, a similar model with delayed triggering facilities on video signals; the CS-1577, another 30 MHz, dual-trace type but with 2 mV/div sensitivity; the CS1575, a 5 MHz general-purpose type with 1 mV/div sensitivity and the CS-1830, a 30 MHz, 2 mV/div, dual-trace type with delayed triggering.

New from Trio is the MS-1650 Digital Memoryscope, a 10 MHz oscilloscope which incorporates an 8 bit x 1024 word digital memory. This scope can store a signal (up to 250 kHz) prior to the trigger pulse and can drive a pen recorder.

PHILIPS SCIENTIFIC AND INDUSTRIAL (Test and Measuring Instruments), 25-27 Paul St, North Ryde, NSW 2113. (02) 888 8222. Philips have quite a large range of oscilloscopes. Probably the most interesting from the general purpose, low cost, point of view is the PM3207, a dual-trace, 15 MHz unit with 5 mV/cm sensitivity. Auto triggering on this unit ensures that the trace will never leave the screen, and a B-invert mode allows inverted outputs from a circuit to be compared with the input. The PM3207 also has triggering on either A or B channel, and TV triggering. ▶

CHRISTIE RAND PTY LTD, 27 Windermere Road, Epping, NSW 2121. (02) 868 1209. The Scopex 4D-10B and 4D-25 are two British-made dual-trace scopes, with 10 MHz and 25 MHz bandwidth respectively. Both are 'value for money' designs, without fancy features or frills, but offer ±3% accuracy on both channels and sensitivity down to 10 mV/cm and up to 50 V/cm. The 4D-25 has signal delay, to allow investigation of the leading edge of a waveform, and a special version of the 4D-10B, the 4D-10B LS, is available with enhanced low frequency performance.

SCIENTIFIC DEVICES AUSTRALIA PTY LTD, 2 Vautier St, Elwood, VIC 3184. (03) 91 2223. Scientific Devices are the Australian agents for **Nicolet Instrument Corporation,** manufacturers of the **Explorer** digital oscilloscopes. Three models are available: the Explorer I is a two-channel 500 kHz unit, the II is a plug-in model with a bit more flexibility, and the III is an expanded unit with digital interface and floppy disk waveform store. The capabilities of these units are too sophisticated to be described here — they literally have to be seen to be believed!

As well as the Nicolet units, Scientific Devices are also agents of the **National** division of **Matsushita,** who produce a range of oscilloscopes ranging from small portable units to a full-spec 200 MHz unit. The Panascope 5 MHz personal units are particularly interesting — they are so small they can be carried in a briefcase.

SWE-CHECK INSTRUMENTS, PO Box 218, Cheltenham, VIC 3192. (03) 95 2942. SWE-Check are agents for **Una-Ohm,** an Italian test gear manufacturer who have several oscilloscopes in their line. The G421DT is a dual-trace 10 MHz unit with 1 mV p-p sensitivity up to 20 V in 11 steps. Also available is the G404DT portable oscilloscope, which operates from rechargeable batteries.

STANDARD COMPONENTS PTY LTD, 10 Hill St, Leichardt, NSW 2040. (02) 660 6066. Standard Components handle the **Hitachi** range of four oscilloscopes in Australia. These are: the V-151, 15 MHz single trace; the V-152, 15 MHz dual-trace; the V-301, 30 MHz single trace; and the V-302, a 30 MHz dual-trace model. They say the V-152 is an ideal serivce oscilloscope, offering 1 mV/div sensitivity and 0.2μs to 0.2s sweep range.

TECH-RENTALS PTY LTD, Stanhill House, 34 Queens Road, Melbourne, VIC 3004. (03) 267 5877. It's not every day that you need a high performance oscilloscope; most of the time a perfectly ordinary machine will do the job. In this situation it may be advantageous to only hire a good CRO when you need one, instead of tying up capital in one that gets used maybe 1% of the time. Tech-Rentals stock a comprehensive range of oscilloscopes from Hewlett-Packard, Tektronix and Trio, all available for rental from two weeks up. In addition, ex-rental equipment may often be bought from them at extremely competitive prices.

TEKTRONIX AUSTRALIA PTY LTD, 80 Waterloo Road, North Ryde, NSW 2113. (02) 888 7066. Tektronix is probably the world's major manufacturer of oscilloscopes, with an extremely broad product line. Their 250-page catalogue lists all kinds of oscilloscopes, including the 7000 series of plug-in instruments and a wide range of portable oscilloscopes. The 400 series portables are of particular interest for general-purpose lab use, with models up to 350 MHz. At the lower end of the scale is the Sony/Tektronix 300 series — the 335 35 MHz dual trace delayed sweep scope, the 314 10 MHz dual trace, long term storage oscilloscope and the 305, a combined battery-powered oscilloscope and DMM.

The 200 series of miniscopes are small enough to be hand-held for service applications. Perhaps of greatest interest to the hobbyist is the T900 series of scopes; the T922, for example is a no-frills 15 MHz dual-trace scope. Also supplied by Tektronix is the **Telequipment** Range of British-made scopes.

The Tektronix range of products also includes scope-related devices such as spectrum analysers, time domain reflectometers and logic state and timing analysers, as well as graphic terminals (based on storage tubes) for computers.

VICOM, 68 Eastern Rd, Sth Melbourne, VIC 3205. (03) 699 6700. The **Leader** brand of test equipment includes a dozen oscilloscopes, including the LBO-520, a 30 MHz, 5mV/div dual-trace model with delay line, and the 25 MHz, 5 mV/div LBO-515 with delayed sweep. At the bottom end of their range, they have two 4 MHz, 20 mV/div models which are intended for the service market, as well as several models, with higher bandwidths and sensitivities, in between.

Latest in the Leader range are two high sensitivity, 10 MHz models (LBO-513 single-trace and LBO-514 dual-trace) and a 75 mm (3"), 20 MHz scope. The latter is model LBO-308 which features a sensitivity of 2 mV/div and a bandwidth from dc to 20 MHz. It incorporates a new TV sync circuit for simple triggering of composite TV signals, phase/level signal comparison and an addition/subtractor function for working with push-pull signals. The LBO-513/LBO-514 models feature sensitivity to 1 mV/div — not usually available on low-cost instruments. Both have 80 x 100 mm displays, z-axis modulation, x5 magnifier and complete trigger controls. The dual-trace unit also provides front panel X-Y operation, Ch-1/Ch-2 trigger selection and alternate/chopped display modes. ●

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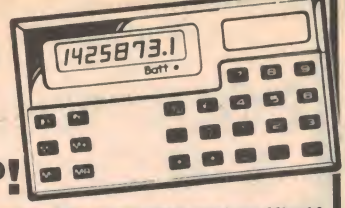

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DEBUG: Debug machine language programs by stepping through one instruction at a time. Several display options, etc. Cat X-3624 **$17.95**

FASTGAMMON: Backgammon players love this program. It provides a skillful opponent. Eight page instruction manual includes rules. Cat X-3625

This program only: **$22.95**

FOR THE TRS-80

Hey, TRS-80 owners: Absorbing and interesting program cassettes miles cheaper than theirs. Look at these:

TIME TREK: (Cat X-3650) A version of the popular Star Trek or Space War.

STIMULATING SIMULATIONS: (Cat X-3652) Ten original games — art auction , forest fire, monster chase, nautical navigation, lost treasure, business management, gone fishing, rare birds, space flight & diamond thief.

ELECTRIC PAINTBRUSH: (Cat X-3654) More than just a picture drawing tool, lets you paint patterns at machine language speeds.

BRIDGE CHALLENGER: (Cat X-3656) For all players from novices to experts, who would like to practice and improve their play.

ALL ABOVE: **$17.95 ea**

Compare our prices to you-know-who!

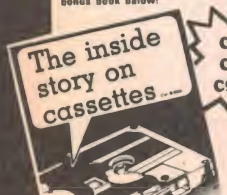
(All above tapes are for level 1 & 11 4k RAM with exception of bridge; which is level 11 16k RAM).

MICROCHESS 1.5: (Cat X-3658) Always ready for a quick blitz game, or a slow thoughtful one.

ONLY **$22.95 ea**

NEW!

Dick Smith cassettes have been up-graded. Brilliant new packaging tells you they're different — find out for yourself just how good they really are! Try a couple of these quality tapes: better still, try ten (tapes can be mixed) to obtain the bonus book below!



C60 LN: **$1.50** ea(Cat C-3350)
C90 LN: **$2.00** ea(Cat C-3352)
C90 EDR: **$2.75** ea(Cat C-3354)

BONUS:

Buy any ten 'Dick Smith' cassettes; or any Dick Smith cassette deck or recorder and receiver FREE a copy of our new book: 'The inside story on cassettes'. Tells you all about this incredibly versatile recording medium, and how to get the best from your tapes and tape recording equipment. Also available separately: Cat B-6035 @ 50c

DON'T GET CAUGHT

(at about 8AM on Tuesday, 25th December as the kids unwrap their presents . . .)

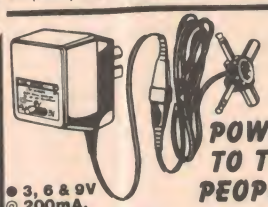
Imagine! All those battery operated toys and no batteries. Wouldn't you be popular?

Remember to stock up now on budget Hi Watt batteries from Dick Smith. Cheaper by far than most brands, yet they're fresh and ready to go to work immediately. All popular sizes:

UM-1 ('D') size	Cat S-3001	25c	ea
UM-2 ('C') size	Cat S-3002	20c	ea
UM-3 ('AA') size	Cat S-3003	15c	ea
'AAA' size (tiny)	Cat S-3004	25c	ea
'006P' size (9V)	Cat S-3006	45c	ea

ALKALINE BATTERY PACKS:
If you prefer, we have famous Mallory Alkaline extra-long-life batteries available. (Two in each pack except 9V type).

'AA' size	Cat S-3280	$1.60 pack two.
'C' size	Cat S-3282	$2.15 pack two.
'D' size	Cat S-3284	$2.15 pack two.
9V (006P) size	Cat S-3286	$2.50 each.



POWER TO THE PEOPLE!

- 3, 6 & 9V @ 200mA.
- 4-way connector & reversible polarity
- Fully Approved!
- WAS $9.50 NOW **$6.90**

Cat M-9525

Every home should have one — or more. This battery eliminator gives 3 voltages, is ideal for most small appliances. Another bargain from Dick — just in time for all those Christmas gifts!

AMATEURS

DON'T FORGET Dick Smith will match or better ANY GENUINE ADVERTISED PRICE on Yaesu or Hy Gain amateur equipment!

MORE OF DICK'S BONZA BULK BUY BARGAINS – BEWDY!

FERRITE RODS:

How's this one — 194 x 9mm ferrite rods normally sell for $2.00 or more. Our normal retail price is $1.50. But as a bonza bulk buy for a short time only: **90 cents!**

Yes, way under price, with dozens of uses for the electronics hobbyist: aerials, chokes, filters, audio supressor circuits, etc, etc. While our super special lasts; first come first served. Don't miss out on this one!

Cat L-1401 **90¢ ea!!!**

YOU REAP THE BENEFIT!

A manufacturer of CBs went broke, so we bought the cases he had made. Must have cost double what we're selling them for! Hundreds of uses for the hobbyist, heavy aluminium case with punched panels as shown. Quick!

Cat H-2507
STRICTLY WHILE STOCKS LAST:

$7.95)

HELP! Calling manufacturers, importers, liquidators, agents, etc etc etc.
If you've any bonza bulk buy bargains similar to the lines on this page, we're interested. You know what we're after — components, etc, which we can offer our hobbyist customers at big savings over normal retail prices. Turn your excess stock into cash by phoning Mark Sim or Gary Johnston on **(02) 888 3200.**

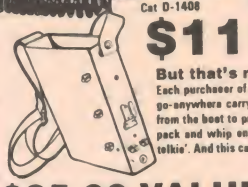
SAILING SAILING. . .

MIDLAND MARINE RADIO FOR SAFETY AT SEA . . .

Cat D-1408

This is the marine radio they're all talking about. Mighty Midland. It comes already fitted with the four marine channels, and has provision for extra channels in the future — no crystals to buy!
No matter what your craft, you need the security that only the Midland 857M 27MHz marine radio can give you. At $115.00, you save nearly $25.00 (was $139.50). Buy now and save!

$115 INCLUDING ALL FOUR BOATING CHANNELS!



But that's not all!
Each purchaser of the Midland 857M receives, as a bonus, our unique go-anywhere carry case, which allows you to remove the transceiver from the boat to prevent theft. With the addition of an optional battery pack and whip antenna, you can also use your Midland as a 'walkie talkie'. And this case is free with your Midland (normally $25.00 extra!)

$25.00 VALUE FREE!

MARINE ANTENNA TO SUIT:
The Dick Smith 'White Swordfish' with exclusive 'any-which-way' base. Strong fibreglass construction, complete with cable and tuning coil. Mounts on any boat ('glass, steel, wood, etc etc.) Cat D-4071

EXCLUSIVE TO DICK SMITH: **$49.90**

'CHANNEL F' CARTRIDGES —

Large shipment of cartridges just arrived – here's your chance to grab some before they disappear again! And you can save money on some!!!!!

A lot of people were disappointed when we ran out of the popular Fairchild 'Channel F' video entertainment computer cartridges. Now the good news: a large shipment has just arrived, putting good stocks of cartridges back in the stores. We've even cut the price on some of the more popular games! Don't delay: stocks won't last long! The following are back in stock:

● Dodge it (Cat X-1216) ● Hangman (Cat X-1218) ● Maze (Cat X-1204) And a brand new cartridge: BOWLING (Cat X-1221) **all above cartridges: $24.50 each**

Save a massive $9.50 on the following:
● Desert Fox (Cat X-1203) ● Blackjack (Cat X-1201) ● Magic Numbers (Cat X-1210) and ● Torpedo Alley (Cat X-1211)

$15.00 ea

CAR $$$$ SAVERS

COMPRESSION CHECKER:
Compression levels tell you a lot about your car's engine, without going into the 'works'. This model has rotary dial, calibrated to 1800kPa, and simply pushes into spark plug holes.

$7.50

Cat A-8506

THIS ONE SOLO FOR $13.50 TOO: SAVE $6.00 FROM DICK!

NEON TIMING LIGHT:
If your timing is out, you're wasting fuel — and money. Check your timing easily and reliably with this neon timing light. Pistol grip for ease of use, pre-focussed super bright neon flash tube. Works with all ignition systems: just connect in series with No. 1 plug.

$9.95

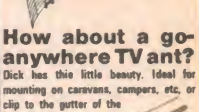
Cat A-8507

THIS UNIT SOLO NATIONALLY FOR $13.50 — SAVE $3.55!

NOTE: As our prices are so far under normal retail, stocks are very limited. Don't miss out! Strictly first come, first served.

UHF TV IS COMING!

Get ready for it with a new UHF TV antenna from Dick Smith. High gain, easy to install, great value. Cat L-4028 **$19.95**



How about a go-anywhere TV ant?
Dick has this little beauty. Ideal for mounting on caravans, campers, etc, or clip to the gutter of the holiday house. Suits all Australian channels. Cat L-4028 **$23.95**

SOMETHING TO PLAY WITH OVER THE CHRISTMAS HOLIDAYS!

Try a TV game IC. We've bought an entire shipment of the famous AY-3-8500 IC from a major manufacturer and we're practically giving them away! Yes, we supply a data sheet to show you how to make a TV game, but at this price you could just about use them as fishing lures! They were selling for $19.75 each. Here's your chance to save a massive $18.00, while they last!

Cat Z-6848 ..... Not $19.75 ..... **NOW ONLY $3.75 each!**

Update your car hi-fi – for a new year of sound!

$149.00

We've searched the world to bring you this beauty. An AM, FM and stereo cassette player that will make your music come alive — whatever your taste! Suits in-dash fitting in the same space taken by a normal car radio (replaces the garbage the car manufacturers often give you!) and operates from 12 volts, negative earth. 4 ohm speakers suit this unit (not supplied). Also has ● tape fast forward ● local/dx switch for radio ● mono/stereo switch (great for noise reduction on FM in difficult areas.) Cat Z-6480

Want a new set of speakers for the car? Dick has a huge range of car speakers, from around $2.00 to our superb co-axial and dual cone car speakers at around $30.00 pair. Call in soon – or check them out on page 23 of our catalog.

$49.95

You can REALLY make your music zing with this car stereo power booster amplifier. It features a 60 watt (peak) circuit (30W per channel), with a frequency response of 25 to 20000Hz. You can use this with virtually any car stereo (it simply connects in series with the speaker leads; instructions provided) and operates from 12 volts. It's powerful enough to overcome road and other noises in virtually any car. Incredible! Cat A-6660

SEASON'S GREETINGS!

Dick Smith and staff wish a happy Christmas and a safe and prosperous new year to all.

And we hope to be of service to you again in 1980.

BUYING BY MAIL?

It's so easy! Simply list the items you want, with their catalogue numbers, and post it off with your cheque to our mail order centre (address at right) Don't forget to include post & packing (charges apply to total order value as per table at right)

Then watch your letterbox!

ORDER VALUE:	P&P
$5 (min) to $9.99	$1.00
$10.00 to $24.99	$2.00
$25.00 to $49.99	$3.00
$50.00 to $99.99	$4.00
$100 or more	$5.50

NOTE These charges apply to goods sent by post in Australia only. Large and bulky items cannot be sent by post.
If you prefer, we will despatch your order by Comet Road Freight to anywhere in Australia for only $6.00 that's below what it costs us! Large and bulky items are normally sent by Comet unless you specify differently (eg by rail or air you pay freight on delivery.)

CHRISTMAS GIFT IDEAS. . .

for technical people; for thinking people; for someone who's got everything!

SOLAR EXPERIMENT KIT – 25-IN-ONE

The science of the 21st century – solar power. Help them learn more about this fascinating field with our budget 25-in-1 solar experimenters kit.

$16.95

COMPLETELY SAFE!

Cat K-2032

150-IN-ONE KIT

150 electronics projects – enough to keep even the keenest person busy for a long, long time. No soldering required with this simple kit – and it is battery operated so it is SAFE! Great value.

53.50

Cat K-2030

Comes in beaut carry case, too!

INCREDIBLE PRICE CUT!

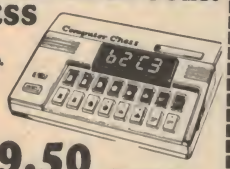
Was selling for $59.95 !!!!!

Yes, we've made a scoop purchase of manufacturer's excess stock – at below manufacturer's cost price! Unit supplied with one channel (27.125MHz) and has provision for second channel (xtals available.) All these units are brand new, and work – but are worth our price in parts alone! Use in conjunction with CB transceiver for paging system!

Cat D-1100 *ONLY*

$12.50! Plus batteries

6 LEVEL COMPUTER CHESS



VALUE!

$99.50 Plus batteries

DICK BREAKS THE $100 BARRIER!

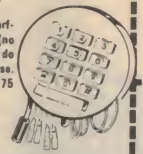
Yes, this incredible chess computer gives 6 levels of play from basic beginner through to very expert; large, easy-to-read LED display makes easy play. Battery or mains operated (optional) will give lasting enjoyment to the chess players in your family. Cat X-1250

PUSH BUTTON PHONE DIALS

We've sold hundreds of these – push button phone diallers, ideal for experimenters systems. They remember the last number dialled (up to 16 digits) for easy re-call if the number is engaged. 4 colour coded wires for easy installation.

ATTENTION: Although these diallers fit perfectly into standard Australian telephones (no soldering required) present regulations do not allow you to use them for this purpose. Cat X-1175

$49.95



LOOK! NO WIRES!

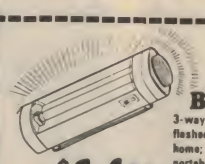
Cat F-1010

WIRELESS INTERCOM

Improve communications around the home, office, factory, etc with this easy to install intercom. Easy? It's easier than that! Just plug them into a power point! That's all. Home to garage, office, to factory, kids room to kitchen — the uses are endless!

$49.50 pr

IN A WORD: BRILLIANT!



3-way light: fluoro, spot and flasher for campers, in the car, home; wherever you need a portable lamp. Hand held or use shoulder strap supplied. Cat X-1084

$14.95

SUMMER TIME IS BARBIE TIME!

But it's also fire ban time. Don't let fire bans ruin your picnic plans. With a Solar Grill from Dick Smith you can have that outdoor barbecue anytime the sun is out – fire bans or not! This incredible space age cooker will do your steaks perfectly – also chops, snags, onions, tomatoes, etc etc. And you don't pay a cent for fuel! It will even boil the water to wash up! (A litre of water boils in approximately 9 minutes in sunlight!)

Cat X 2001

$95.00

(It might sound expensive, but remember you never have to pay for fuel to use it!)

24 TUNE DOOR BELL

Remember the 'Chromachime'. We sold thousands! Here is a fully built up version of this popular circuit. 24 tunes, fully selectable. Comes complete with push-button for external mounting; so you don't have to buy one! Smart wood grain finish, ideal for mounting on or near door. Incredible value at our super introductory price:

(The Chromachime was $49.50, in KIT form, and without a front door push button! Incradible!!!!).

Cat X-1130

$35.00

A CB FOR XMAS?

The CB scene has quietened down: it's now really worthwhile. If you've been put off by press reports, think again. CB for safety . . .

MIGHTY MIDLAND AM

~~$129.50~~

$89.50

Midland 882: Australia's most popular CB. Great range, great performance. Easy to operate, too. Makes a good 'start-up' set. Cat D-1436

RIGHT Popular magnetic base CB antenna No holes to drill, sticks to roof of vehicle Cat D-4412 ~~$19.50~~ **$16.50**

Mighty Midland SSB – for when you're really serious. Tremendous range and performance, unique features. Midland SSB: the Rolls Royce of CB radio. Cat D-1700

SUPER SSB

~~$239.50~~

$199.50

DON'T FORGET! We have a huge range of CB radios and CB radio accessories. For anything in communications, see the experts at your nearest Dick Smith Electronics store.

IT'S ABOUT TIME . . .

STOPWATCH/TORCH

Incredible! A stopwatch that can do splits, lap timing, etc down to 1/100 second, in a tiny case that also includes a torch! LCD readout for long battery life, highly accurate.

Note: due to demand stocks may be low until mid month!

Cat X-1043

$39.50

PS. It's a clock, too!

VALUE FOR THE MOTORIST:

Quartz chronometer accuracy; large, easy-to-read fluorescent digits. Operates from 12 volts, takes less power than your dash lights. Easy to instal, bracket supplied. As shown, with case: Cat X-1047

$24.50

Unit without case (for installation in dash): Cat X-1045 **$19.50**

STILL THE BEST VALUE!

THE IMPROVED DICKTRACER Mk II — Australia's greatest value in a radar detector! Why spend $100 and more when all you need is a Dicktracer. Internal batteries recharge overnight from the cigar lighter so there's no trailing leads. Value!

$49.50

Cat A-8500

TOOLS MAKE GREAT CHRISTMAS GIFTS!

40PC SOCKET SET:

Ideal for the mechanic, home handyman, etc. Metric and SAE sizes suit all uses, with ratchet drivar too! You'd pay dollars more elsewhere! Cat T-4670

$16.50

NIBBLING TOOL

Hands up if you've ever wanted to cut holes in thin sheet metal, PCB's, etc. Here's the answer: a handy nibbler. Cuts out holes, shapes, lines, etc in thin metal or plastic, etc. No handyman should be without one. Cat T-4940

$12.50

TOOL/HOBBY BOX

Talk about handy! This strong tool or hobby box locks for security (padlock not supplied) and opens out to reveal generous storage area with two storage trays for bits and pieces. Ideal for the electronics enthusiast especially, but also great for a host of other hobbies Cat H-2600

$19.50

Just a few of the hundreds of great gift ideas from our tool and hobby centres: at your store!

NEW KITS

(and new kit components)

Remember: parts for most kits in most of the electronic magazines are normal stock lines. So even if a kit isn't listed, we may be able to help you anyway. Call in and ask us!

TRANSISTOR ASSISTED IGNITION (See EA December)

Complete kit including instructions	Cat K-3300	$32.50
Printed circuit board	Cat H-8367	$2.20
BUX80 power transistor	Cat Z-2150	$10.95

FAN SPEED CONTROL (See EA December)

Short form kit (PCB, components; no h'ware)	Cat K-3090	$11.50
Printed Circuit Boerd	Cat H-8368	$1.60
SC141D Triac	Cat Z-4510	$1.28

(zippy box, etc, normal stock lines – or build it in to applience.)

NEW METAL LOCATOR (See EA November)

Complete kit (excluding dowell & former)	Cat K-3504	$19.50
Printed Circuit Board	Cat H-8366	$2.40

INFRA-RED REMOTE CONTROLLER (See EA October)

CQY89A Infra red diodes	Cat Z-3235	$1.50
BPW34 photo transistors	Cat Z-1954	$3.50
Printed circuit boards (pair)	Cat H-8365	$5.95

PROCESS TIMER (See ETI October)

Printed circuit board	Cat H-8623	$3.95

DISCO STROBE Mk 11 (see ETI September)

Complete kit, including instructions	Cat K-3152	$34.50
Printed circuit board	Cat H-8572	$1.95
Flashtube	Cat S-3882	$2.95
Trigger transformer	Cat M-0104	90c
Discharge capacitors (each)	Cat R-2855	$3.75
Reflector	Cat K-6016	$4.50

WINDSCREEN WIPER DELAY (See EA September)

Printed circuit boerd	Cat H-8364	$2.50

Other components for this project are normal stock lines.

AUTO CHIME (See EA September)

Complete kit	Cat K-3502	$29.75
Printed circuit board	Cat H-8363	$3.70
TMS-1000 Integrated Circuit	Cat Z-6825	$16.50

INDUCTION BALANCE METAL DETECTOR (See ETI)

Short form kit (not inc. dowell or former)	Cat K-3100	$35.50
Printed circuit board	Cat H-8578	$1.50

MASTHEAD AMPLIFIER (See EA August)

Complete kit	Cat K-3232	$29.50
Printed circuit board	Cat H-8362	$2.50
OM350 integrated circuit	Cat Z-6185	$9.95
Diecast box	Cat H-2221	$3.00
Zippy box	Cat H-2751	$2.50

9kHz WHISTLE FILTER FOR TUNERS (See Feb EA)

Complete kit, including instructions	Cat K-3496	$19.75

MAJOR DICK SMITH RESELLERS

Listed below are re-sellers who stock a large range of our products. However, we cannot guarantee that they will have all items in stock or at the prices we advertise.

A&M Electronics
78 High Street, Wodonga, Vic. Ph 244 588
Advanced Electronics
5e The Quadrant, Launceston Tas. Ph 317 075
Aero Electronics
123e Bathurst Street, Hobert Tas. Ph 348 232
Peter Brown Electronics
9 Doveton Street North, Ballaret Vic. Ph 323 035
Crystal TV Rentals Pty Ltd
66 Crystel Street, Broken Hill NSW. Ph 6897
Decro Electric
Cnr Magellen St & Bruxner Hwy, Lismore NSW. Ph 214 137
Elektron 2000
44 Brown Road, Broadmeedow, Newcestle NSW. Ph 691 222
D & M Harrington
6/1 Machinery Drive, Tweed Heads South, NSW. Ph 364 589
Hutchesson's Communications
5 Elizabeth Street, Mt Gambier SA. Ph 256 404
Keller Electronics
218 Adelaide Street, Maryborough, Qld. Ph 214 559
M & W Electronics
48 McNamara Street, Orange NSW. Ph 626 491
Mellor Enterprises
Shop 2/15 Forsythe St, Whyalle Norrie, SA. Ph 454 131
Power & Sound
147 Argyle Street, Traralgon, Vic. Ph 743 638
Purely Electronics
15 East Street, Rockhempton, Qld. Ph 021058
Stevens Electrical
42 Victorie Street, Mackay, Qld. Ph 511 723
Sumner Electronics
95 Mitchell Street, Bendigo, Vic. Ph 431 977
Sound Components
78 Brisbane Street, Tamworth NSW. Ph 661 363
Trilogy Wholesale Electronics
40 Princes Hwy, Fairy Meadow, Wollongong, NSW. Ph 831 219
Tropical TV Services
249 Fulhem Rd, Vincent, Townsville Qld. Ph 791 421
Variety Discounts
113 Horton Street, Port Macquarie NSW. Ph 835 486
Wagga Wholesale Electronics Sales
82 Forsyth Street, Wagga NSW.
Wellington Electrical Services
110 Lee Street, Wellington NSW. Ph 325

DICK SMITH ELECTRONICS

NSW	125 York Street, SYDNEY	Ph 290 3377	VIC	399 Lonsdale St, MELBOURNE	Ph 67 9834
	147 Hume Hwy, CHULLORA	Ph 642 8922		656 Bridge Road, RICHMOND	Ph 428 1614
	162 Pacific Hwy, GORE HILL	Ph 439 5311	QLD	166 Logan Road, BURANDA	Ph 391 6233
	30 Grose Street, PARRAMATTA	Ph 683 1133	SA	203 Wright St, ADELAIDE	Ph 212 1962
	263 Keira Street, WOLLONGONG	Ph 28 3800	WA	414 William St, PERTH	Ph 328 6944
ACT	96 Gladstone St, FYSHWICK	Ph 80 4944			

EXCEPT WHERE NOTED, ALL ITEMS SHOWN IN STOCK AT PRICES GIVEN AT TIME OF GOING TO PRESS.

MAIL ORDER CENTRE: PO Box 321, NORTH RYDE NSW 2113 Ph 888 3200. PACK & POST EXTRA.

bankcard welcome here

SHOPS OPEN 9AM to 5.30PM (Saturday: 9am till 12 noon)
BRISBANE: Half hour earlier
ANY TERMS OFFERED ARE TO APPROVED APPLICANTS ONLY
RE-SELLERS OF DICK SMITH PRODUCTS IN MOST AREAS OF AUSTRALIA.

The ins and outs of solar cells

Energy derived from fossil fuels — the world's major source of energy today — was originally provided by the sun, converted by photosynthesis with an efficiency of about 0.025%! Compared to modern solar cells, which have an efficiency around 12%, we're on a real loser with fossil fuels. However, at the moment, they're convenient — but they won't always be so.

Here is a short, practical guide to solar cells, their uses and abuses.

WE HAVE ALL BECOME vitally concerned about our energy resources, and rightfully so. Most people see the energy crisis in terms of paying more for a tank of petrol, but the implications run much deeper than that. Just think how many commodities are based on the oil industry – the pen I use to write with is plastic, the table top is plastic veneer, even the carpet is synthetic – all made from petroleum products.

A very large percentage of our business trade is in oil-based products e.g: clothing, photography, medicine, and household goods, to mention just a few. In fact Western economies are based so heavily on oil products that, if anything suddenly happened to the supply, most western nations would collapse.

An enormous amount of energy is radiated by the sun. It is, in fact, our primary energy source. On a clear day the Earth receives about one kilowatt of solar energy per square metre on its surface. About 30% is reflected back into space, 47% is converted into heat, the rain cycle uses another 23% (which can be tapped to provide hydro-electric power in suitable mountainous areas) while wind, waves, and convection currents account for about 0.25%.

The remainder, about 0.025% (!), is stored by photosynthesis in plants. It is this energy that eventually goes to make coal, oil, and shale oil. The energy derived from petroleum which we use so extensively today is the accumulation of this trickle of energy into photosynthesis over millions of years. No wonder it's running out!

In fact it has been estimated it would take six million years of photosynthesis to provide us with an extra six months of oil and coal!

Solar energy can be harnessed in many different ways. Hydro-electric power is a result of the rain cycle;

A set of experimental 'demonstration' solar cells made here by Philips at their Hendon, S.A., plant.

thermal gradients in tropical oceans have been used in an experimental generating station off Cuba as long ago as 1929; wind power is showing promise with experimental generating stations using large windmills and solar collectors have been devised to capture some of the heat which would otherwise be re-radiated and lost, converting it to hot water for domestic and commercial heating.

What solar cells offer

Solar cells offer a much brighter future (. . . pardon the pun) as a source of electrical energy. Firstly, they provide energy in a clean, transportable, convenient form – electricity. The predominant source of energy for electrical generation today comes from fossil fuels and hydro-electric schemes. A very few generating schemes use hydrothermal energy from natural hot springs.

Secondly, solar cells can provide energy very close to the point of consumption without requiring the transmission of energy across a distance or replenishment of fuel. Very handy in isolated locations.

Thirdly, they're relatively efficient . . . and they have a long life.

One shouldn't forget, too, that they are made from the most common substance on Earth – silicon.

To date, the most extensive use of solar cells has been in space. They have been employed as power sources for satellites for many years. Research has improved the efficiency of solar cells over the years, and the position is likely to steadily improve with continuing research.

Solar power satellites are currently being studied (see ETI, April issue this year). It is proposed to assemble huge solar cell arrays in space and beam the energy back to Earth via a high power microwave transmission, enormous antennas ("rectennas") on Earth converting the microwave energy directly to electricity for distribution.

Terrestrial use of solar cells has expanded rapidly in the last few years. Remote telecommunications installations seem to be making the greatest use of the advantages offered. Some radio amateur VHF repeater stations in

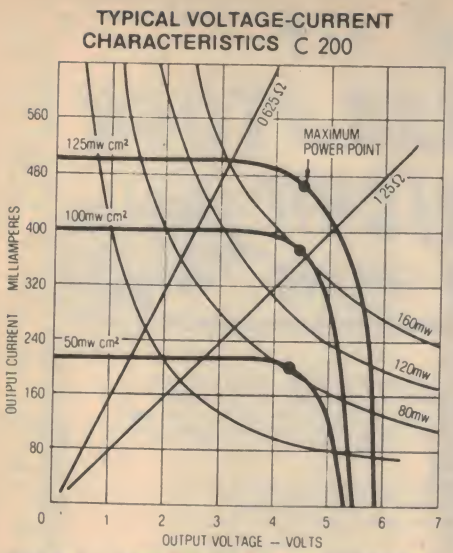


Figure 1. **Typical voltage/current characteristics of a solar cell. (Sensor Technology, type C200, distributed by Amtex Electronics).**

Australia employ solar cells to maintain charge in storage batteries used to power the installation. They are also used to charge batteries on ocean-going yachts. So you can see that hobbyists as well as professionals have been getting into the act.

Solar cell characteristics

The voltage/current characteristics of a typical single solar cell are illustrated in Figure 1. Power output contours are also shown.

At low loads (relatively high load resistance), output from the cell will be pretty nearly a constant voltage – around 0.55 V to 0.6 V – depending on the amount of energy received. If the load is increased (by reducing the load resistance), output current (and load power) will increase in proportion until a point is reached where the output voltage rapidly 'turns over', dropping sharply if the load resistance is further decreased. In this region, the load current will remain virtually constant. Maximum power output, for a given level of energy falling on the cell, occurs at the 'knee' region of the characteristics.

The performance of a solar cell depends on the spectral distribution of the irradiation impinging on it, thus, the amount of power per unit area falling on a solar cell is not a measure of the total irradiation. The term *insolation* is used to specify both the amount of power and the spectral distribution of radiation falling on a solar cell.

The relative spectral response of a typical solar cell is illustrated in Figure 2. Part of the efficiency loss in solar cells results from the fact that their spectral response does not match the spectral output of the sun. Further energy is lost in the unused excess of energy of the absorbed photons. Conversion efficiencies at an insolation of 1 kW/m^2 (100 mW/cm^2) for typical solar cells ranges between 8% and 12%.

Solar cell arrays

The most convenient way to obtain power from solar cells is to mount a number of them in an array and connect them so as to provide a useful voltage at some convenient current or power rating. Accordingly, manufacturers make 'panels' of solar cells, constructed by encapsulating individual cells in silicon resin between two plates of glass, generally with an extruded aluminium surround for the edge, with the cells connected in series. The glass plates are chemically hardened (tempered) and made very smooth to reduce the build up of dust or other residues. This is especially important where the panels are used in remote locations.

Since most of the energy falling on the panels is converted to heat and lost, the panels have to be able to conduct the heat away by convection (primarily) or conduction. Some panels are ▶

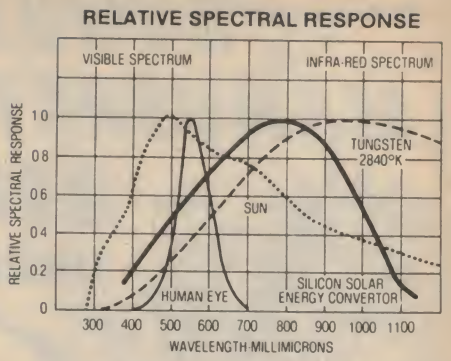


Figure 2. **Relative spectral response of a solar cell. Efficiency would be better if the response matched the Sun's output more closely.**

SILICON SOLAR CELL – HOW IT WORKS

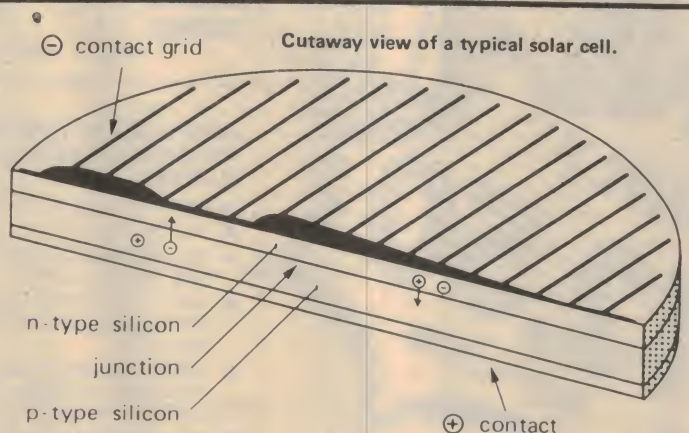
A SOLAR CELL can be considered as a large-area silicon diode. Because it consists of a p-n junction, the junction will have a barrier potential associated with it (harking back to your diode theory) when no radiation falls on the cell. There will be an excess of electrons on the n-side of the junction (supplied by donor atoms from the doping material), some of which will diffuse across into the low electron density region on the p-side of the junction. This diffusion leaves ionised donor atoms ('holes') which create a positive space charge in the n-region close to the junction. The electrons which diffuse into the p-region will find acceptor atoms and will no longer be free to roam. This creates a negative space charge near the junction. That's how the barrier potential comes about. But, you won't be able to measure it.

The barrier potential, V_B, can be thought of as a contact potential. If contacts are made to the p-region and the n-region (with the same metal) and a high impedance voltmeter connected, no voltage will be measured. The contact potentials will cancel. Looking at the diagram, with no light falling on the cell, V_B will typically be –0.7 V, V_{C1} +0.5 V and V_{C2} +0.2 V. Hence, you won't read a thing on the meter.

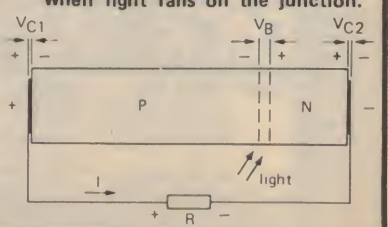
If the cell is now irradiated with light, electron-hole pairs will be generated in the junction region, separated by the field associated with V_B, the holes being forced to the p-side and the electrons to the n-side. i.e.: they move across the junction. Consequently, the barrier potential will fall considerably, to say 0.1 V!

However, the p-contact will then be at a potential 0.6 V above that of the n-contact. Now, you can measure this! With sufficient irradiation, electrons charge across the junction from the p-region to the n-region – via a load and round again if you want the solar cell to do work. Thus, convential current flow will be from the p-contact (which becomes the positive terminal) to the n-contact via a load. The maximum current obtainable is approximately proportional to the level of irradiance and the area of the cell.

Conversion efficiency of solar cells ranges between 8% and 15%, typically 10-12%, under a standard solar irradiance of 1 kW/m^2 (100 mW/cm^2). It is limited by three main factors: firstly, only part of the Sun's available spectrum is used: second, the absorbed photons have an unused excess of energy and lastly, some of the electron-hole pairs created are lost through recombination.



Cutaway view of a typical solar cell.



Representation of a solar cell showing the contact and barrier potentials. V_B falls considerably when light falls on the junction.

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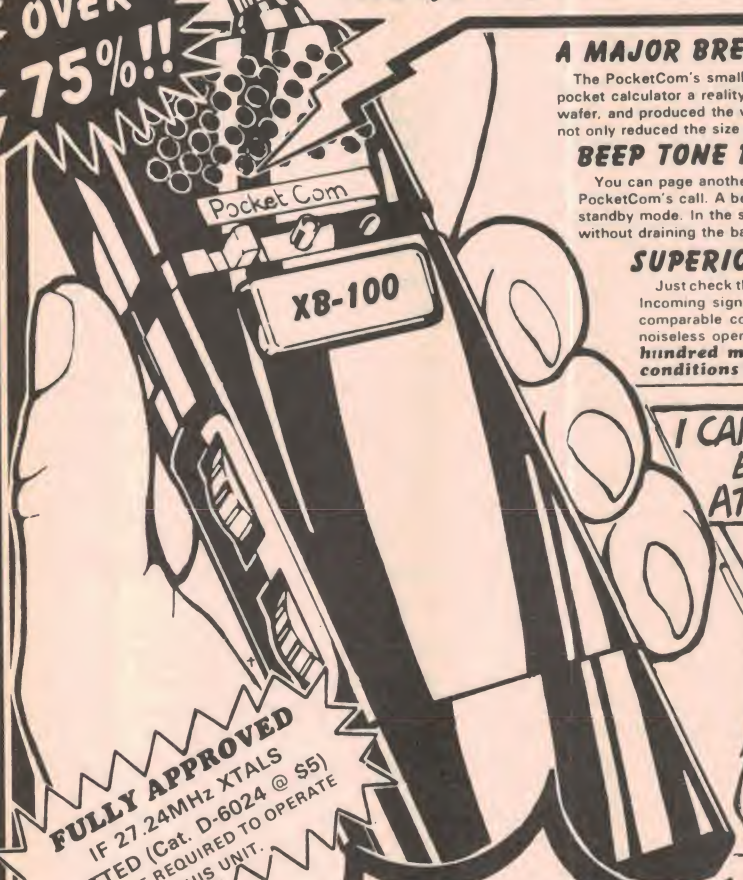

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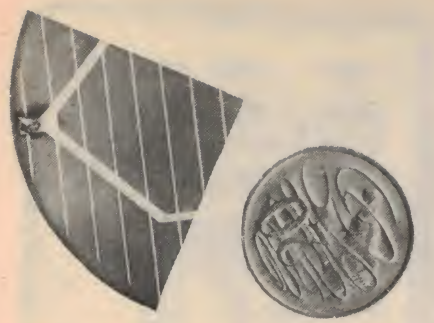


A solar cell 'piece' from Sensor Technology, type C202, used in projects in this issue.

provided with a sturdy, cast aluminium frame at the rear which serves as a heat dissipator for the array.

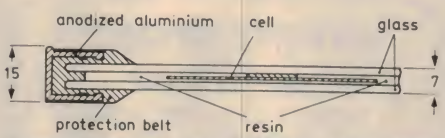
High temperatures on a solar cell panel have to be avoided, otherwise damage may result. Although individual cells can withstand quite high temperatures before they suffer structural damage, the resin potting compound cannot. Excessive heat induces strains in the resin, causing it to tear away from the surface of the cell, leaving a gap, and decomposition of the resin due to excessive temperatures can cause discolouration. The results of these two effects combine to attenuate the light falling on the cell, decreasing its efficiency.

It is important that solar panels are used within the Safe Operating Area Limits (SOAR) given in manufacturers' data. Most panels are designed so that, when used singly – for charging a storage battery, for example – they cannot be damaged. Series and parallel connection requires care to avoid excessive dissipation in particular cells. Notes on avoiding problems are given a little later in the article.

Load considerations

Operating solar cell arrays into a fixed load resistance is not ideal since, at different levels of insolation, the output voltage and current will vary and thus the maximum power output point varies. Thus, the optimum load resistance should be different for different levels of insolation. If a secondary battery (an accumulator – such as a lead-acid or nickel-cadmium type) is used as a load, this problem is largely overcome.

As an example, let's examine the characteristics of a typical solar panel – the Philips BPX47A, Figure 3. It delivers a maximum power output of almost 10 watts at a peak insolation of 1 kW/m^2 into a load resistance of 20 ohms. At half that insolation level (500 W/m^2), power in a 20 ohm load would only be 2.9 watts. For a 12 volt accumulator (see the 'battery load line'), power delivered to the battery at peak insolation would be a little under 10 watts, but at 500 W/m^2 insolation it would be 4.8 watts.



Construction of the BPX47A solar panel

For this reason, solar panels are manufactured with the correct number of cells to charge a (nominal) 12 V storage battery (34 in the BPX47A). The solar cells are able to work at near-optimum efficiency and the storage batteries can provide peak demands of the power-consuming equipment and bridge overcast periods and night time when the panel receives little or no energy.

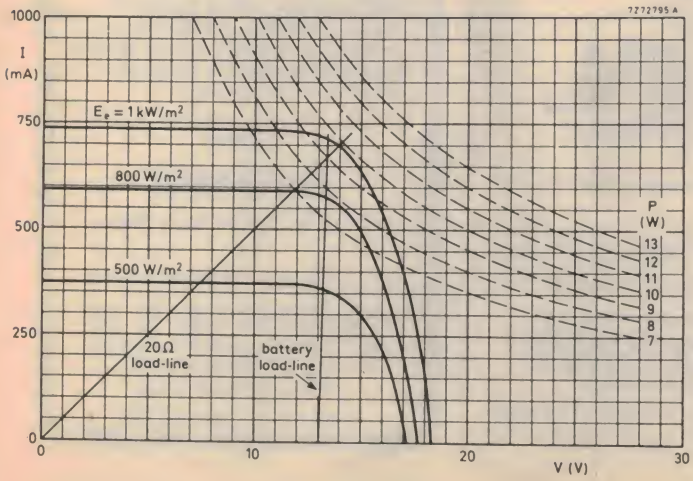
Series connection of solar cells

Any number of solar cells may be connected in series to give a desired output voltage. There are however, some points to remember. If all but one of the cells are in shadow, the irradiated cell will not be able to overcome the barrier potentials of the shadowed cells (since all their barrier potentials are in series) and no current will flow. Taking that a little further, sufficient cells in a solar array must receive irradiation so that the barrier potentials of the remaining cells can be overcome. In the extreme case, what happens when only one cell in an array does not receive sufficient irradiation? The irradiated cells will then force a current through it and the cell will develop a *reverse* voltage across it and thus dissipate power. The actual dissipation will depend on the amount of shadowing. If the irradiance to shadowed cell increases, the power dissipated will *increase* as more current will be able to flow through it, but until the cell can produce the same current as the others – by receiving the same irradiation – it will remain reverse-biased.

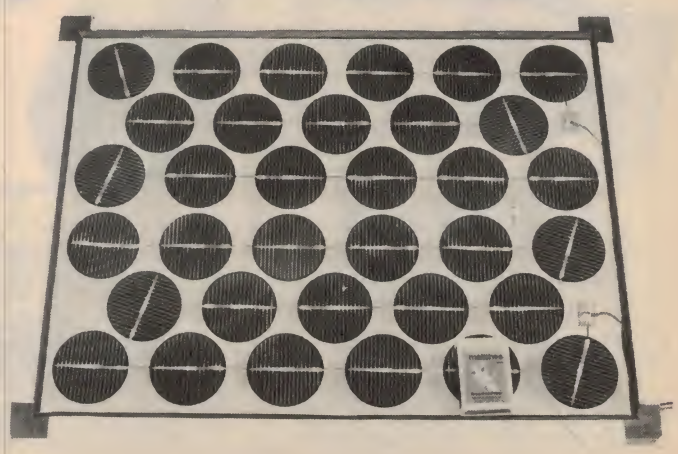
The maximum dissipation of a cell is limited by its area. As a guide, the dissipation should be less than the maximum power received at an insolation of 1 kW/m^2. For example, the area of one cell in the Philips BPX47A is 26 cm^2 and thus the maximum dissipation is 2.6 W. For the Sensor Tech. C200 (characteristics given in Figure 1), which has an area of 20 cm^2, maximum dissipation is 2.0 W.

An effective way of limiting the dissipation is to place a protection diode across each cell to short out any reverse voltage across the cell. This is a rather expensive solution and is unnecessary if the cells are used to charge a battery as the constant voltage characteristic of the battery will limit the maximum voltage which can be developed across any one cell. This is another reason why solar panels are designed to feed a storage battery. If however, several panels are connected in series a protection diode must be connected across each panel to limit the maximum reverse voltage. ▶

Figure 3. **Characteristics of Philips' BPX47A solar panel.**



Philips' BPX47A solar panel (matchbox for size comparison.)



Parallel connection

If cells are connected in parallel to supply a higher current the voltage across each cell will obviously be the same. However if one cell receives less insolation than the others, the shadowed cell will be biased into its forward region and current will be forced through it from the other cells receiving full insolation.

In the worst case one cell in a parallel-connected array will be shadowed and the rest will receive full light. All the energy from the irradiated cells will be dissipated in the shadowed cell and it will heat up. For this reason individual cells should not be connected in parallel.

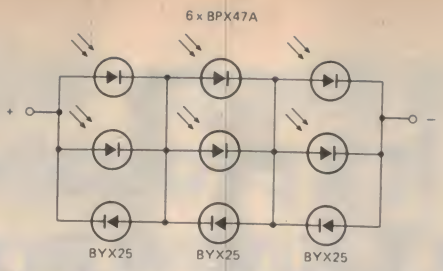


Figure 4. **Matrix connection of a solar panel to improve output. The BYX25s serve as protection diodes.**

When solar panels, or chains of series-connected cells are connected in parallel, the dissipation in a shadowed panel will be equally divided between each of its cells. In the case of the BPX47A panel with 34 cells in series the temperature rise is limited to such an extent that up to 12 panels can be safely connected in parallel.

Solar panels in series and parallel

For higher voltages and higher currents a number of solar panels can be connected in a series-parallel combination. To limit the dissipation in any panel a matrix is used as shown. With the Philips BPX47A panel, for example, the matrix must be three series by two parallel. Protection diodes are still required across each panel to limit the dissipation in individual cells; Figure 4 shows how. ●

We are indebted to Ampex Electronics and Philips for assistance with this article.

EXPERIMENTING WITH SOLAR CELLS

There are a number of interesting and instructive little experiments you can perform with solar cells. There are a number of small hobby-type electric motors around which require only 100 mA, or less, which run quite happily from 1½ V. Four Sensor Tech, C202 cell pieces or Dick Smith Z-4820 cells, connected in series, will power one of these motors. Why not convert a small battery-driven toy?

Electroplating, especially when doing it with precious metals, works best with low current density, long period operation. This method gives a beautifully smooth finish. A solar plater set-up is illustrated in the accompanying diagram.

The wirewound pot is adjusted to give 5-10 mA of current for small items, three to five times that for larger items, and the process allowed to run for three or four hours or longer, depending on the results you want. There's plenty of room for experiment here.

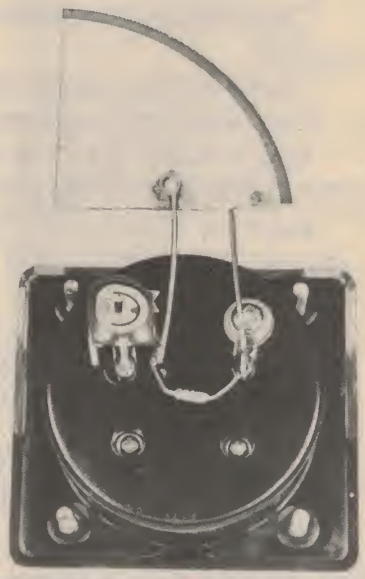
Copper plating is quite easy, and probably simplest to start out with as the ingredients are readily obtainable. The plating solution is copper sulphate and a large piece of copper wire (sanded until it's bright) will serve as the anode. Don't use a metal plating bath — remember!

Another interesting device to experiment with is a sun (or light) intensity meter. The circuit and construction details are shown here. We mounted all the bits on the terminals of a small 1 mA meter. The solar cell we used was a single Sensor Tech. C202. The device works as follows: When driving a low resistance load, the current through the load is pretty well directly proportional to the insolation (energy falling on the cell), the voltage output varying only over a small range.

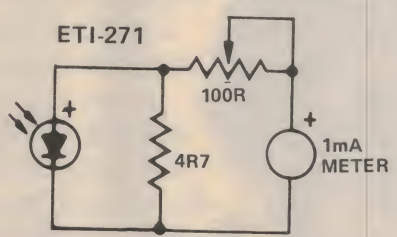
To use it, hold the device at arm's length and turn your back to the sun. Angle the unit to peak the current reading. Calibrate it by adjusting the trim pot to get a full scale reading on a bright, cloudless summer day. Full scale then represents something close to 100 mW/cm² insolation. The scale is fairly linear.

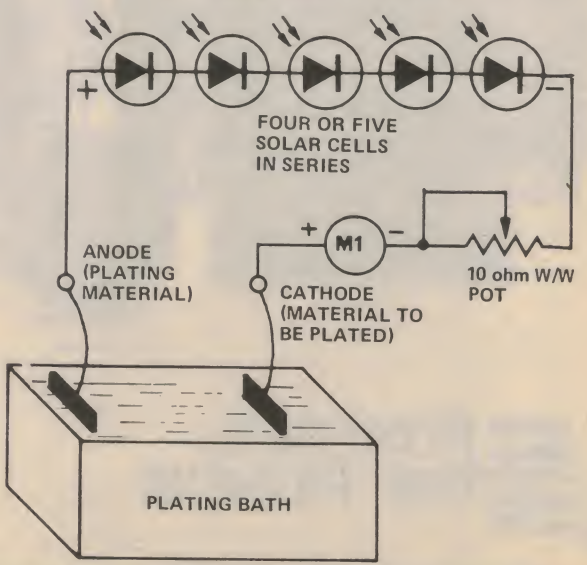
Solar cells make excellent photosensors and may be used in such applications as light-operated relays, photodensitometers, receiver for a light-beam communicator etc, etc.

Front view of the sun intensity meter we made as an experiment. The cell we used is a Sensor Tech. C202, quarter of a C200.



Rear view of the sun intensity meter showing how the cell was mounted on two pieces of 18 gauge tinned copper wire.





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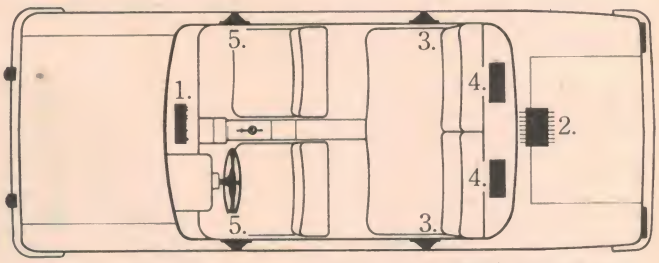

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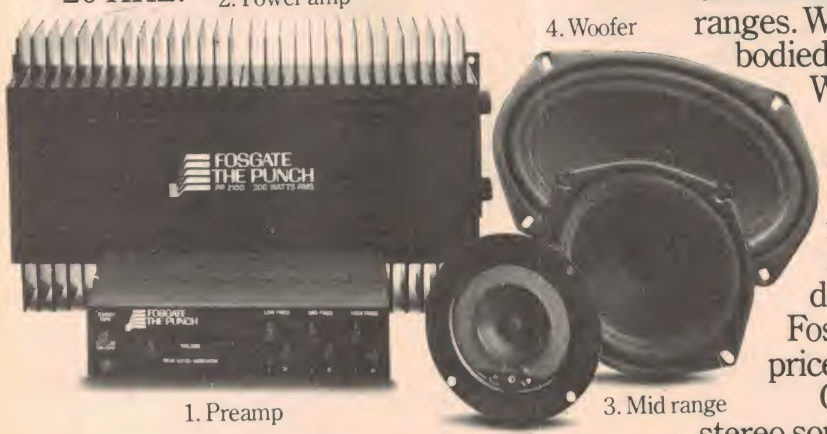

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Beginners guide to project construction

Just starting out in electronics? Here's a host of handy hints and tips to guide you through project construction and help ensure success.

THERE ARE several different ways of building electronics projects.

The simplest by far is to use a printed circuit board. Boards, etched and drilled for specific projects are readily available from most kit set and component suppliers. (See our 'Shop-around' and 'Kits for Projects' pages).

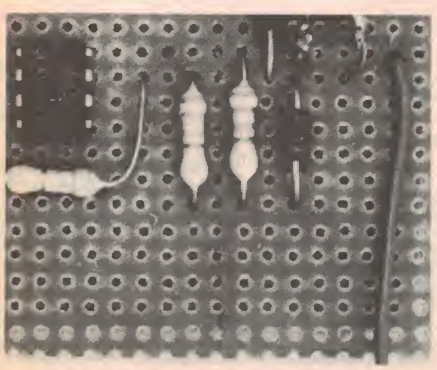
Other methods of construction include matrix board and tag strips. Here we discuss the advantages and disadvantages of each method and show how each technique is used.

Matrix board

This is a phenolic material (like very hard cardboard) perforated in a grid pattern. It is a brittle material, though quite strong – don't bend it too much or it will fracture. Cutting it to size is a simple matter. Score along a line of holes with a pen knife or similar, clamp it along the score on the edge of a sharp corner, such as the edge of a bench or table, and bend or strike the over-hanging portion sharply. It should fracture cleanly along the score.

You use it by inserting the components through appropriate holes and make the necessary interconnections by joining the components across the back (non-component side) of the board. It all sounds a bit messy but it's surprising how quickly circuits can be assembled, and with a bit of care they look quite neat.

Another advantage of matrix board is that components and wiring can be placed exactly as shown on the circuit diagram. The main disadvantage is that the back of the board becomes a bit of a rat's nest if you try to build a complex circuit. Another minor drawback is that the finished job doesn't look like a totally professional unit.



Matrix board construction is convenient, especially for experimental projects.

Tag strips

Tag strips consist of a series of metal tags mounted on an insulating strip. The strips in turn are mounted on two or more further metal tags which are used to screw the whole lot down onto a chassis.

Component leads should never be wrapped more than three quarter-way round a tag. If you twist them right round you'll have an awful job trying to remove them, if you need to, at a later date.

Tag strip construction is quick, cheap, and simple. But the method is only really suitable for small scale projects as inter-tag wiring is otherwise extensive and tedious. The method also wastes space.

Printed circuits

Printed circuit boards simplify electronic circuit building enormously – to the extent that some enthusiasts feel it is reducing the pastime to 'painting by numbers'. But if you feel that strongly about it you can always etch and drill your own boards!

The board material is made of phenolic resin or glass fibre with a thin copper sheet bonded to (generally) one face. Intercomponent wiring is formed by etching away the unwanted copper – so that only the tracks and component mounting pads remain.

Holes are drilled for the components which are then inserted through from the non-copper side and their leads soldered directly to the copper pads.

Most component and kit set suppliers stock printed circuit boards already drilled and etched for most popular projects. They also stock circuit board material for those who wish to make their own boards. Board making is not difficult but it is a rather lengthy process and is beyond the scope of this article.

Printed circuit boards have a number of significant advantages over other methods of construction. The biggest is that mistakes are less likely to occur. Most of the wiring is right there, etched onto the board, and the drilled pattern is such that in many instances components will only fit the right way round. The finished article looks professional – how most professional equipment is made.

The disadvantages are that printed circuit boards are more expensive than other methods. There is also less personal involvement unless you make your own boards – then there's a great deal more!

Our own view is that all methods should be mastered but that printed circuit boards are probably best for most projects.

Soldering

Good soldering is vital – most of the problems that beginners have with their first projects are due to poor joints. The following hints will aid you to become adept at soldering.

- Purchase a good quality iron with a wattage rating between 15 and 25 watts.
- Use only resin-cored solder (60/40

Typical tag strip construction.

RESISTOR COLOUR CODE (standard carbon series)

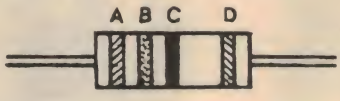
To read the colour code, hold resistor with code ring nearest to end at left hand side.

Colour	1st ring; 1st figure	2nd ring 2nd figure	3rd ring multiplier	4th ring tolerance
black	–	0	1	–
brown	1	1	10	±1%
red	2	2	10^2	±2%
orange	3	3	10^3	–
yellow	4	4	10^4	–
green	5	5	10^5	–
blue	6	6	10^6	–
violet	7	7	10^7	–
grey	8	8	10^8	–
white	9	9	10^9	–
silver	–	–	10^{-2}	±10%
gold	–	–	10^{-1}	±5%

No fourth colour indicates ±20% tolerance

Grade 1 ('high-stability') resistors are distinguished by a salmon-pink fifth ring or body colour.

Example: Resistor coded as A – grey, B–red, C–orange, D–gold indicates a value of 82 kilohms ±5%.



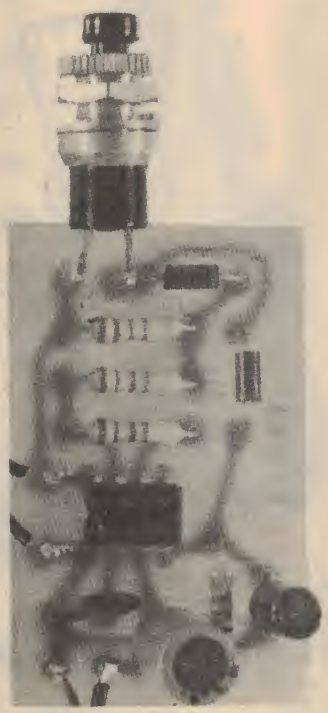
Always heat the joint with the iron first, then apply the solder to the point where the iron touches the joint. The solder should flow quickly and evenly, "wetting" the pieces being joined.

Once the joint is made and the solder has cooled, clip off the excess component lead.

tin-lead content). Do not use acid flux.

- A new, or worn, iron will need tinning. To do this let the iron get quite hot and file the tip smooth to expose fresh clean copper. Quickly, before the copper has time to discolour, apply resin-cored solder – it should flow all over the tip forming a shiny coating.
- Keep your soldering iron clean. Wipe it frequently with a damp cloth or sponge.
- Make sure the connection to be soldered is clean. Wax, frayed insulation, and other foreign substances will result in inferior joints.
- With older components, or copper wire, it will be necessary to clean and tin the individual components before soldering them together (see above).
- Attach the wires to be soldered. Do not make more than a half turn in a lead to be soldered – twisting makes subsequent removal difficult.
- Heat the connection with the iron and apply the solder to the connection. Do not melt solder on the iron and carry it to the joint.
- Keep the iron on the point until the solder just commences to flow on the connection. Too little heat results in a high-resistance joint (known as a dry joint). Too much causes component damage and evaporates the tin component, again causing a poor joint. This step requires practice.
- Let the solder harden before moving the connection. Then check for a smooth bright joint. A joint that has been moved will have a crystalline appearance, may have a high resistance and will fracture easily.

Good soldering is a matter of practice. If you follow the above hints, it will be only a matter of time till you are making professional joints.



A project constructed on a pc board. This method considerably reduces the possibility of wiring errors, though care is needed with orientation of some components.

Finding your way around components

Most beginners have little trouble identifying components after a little experience, but remembering which way around they go can often prove somewhat confusing! Here's how to avoid the pitfalls and assemble projects knowing you've put the components in correctly and how to make simple substitutions.

Resistors

Resistors are fairly straightforward components. If you use the value and wattage specified for a project, there's little that can go wrong. The colour code chart reproduced here is a handy guide if you are not completely familiar with how to read the value from the coloured bands painted on the body of the component. (An article on resistor marking codes and how to read them appeared in the March 1977 issue of ETI).

Resistors are not 'polarised' – that is, it doesn't matter which way round you put them in.

They can be damaged by clumsy handling. Don't bend the leads too near the body of the component, this can ▶

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fracture the end or the main body – the lead may even come right off. Don't apply excessive heat to the leads when soldering, or hold the iron to the joint for too long. It is sufficient just to have the solder flow properly to make a good joint – a 'little extra' may do more harm than good.

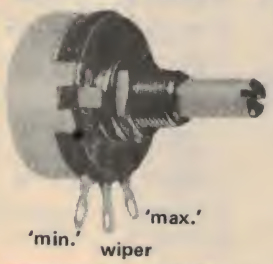
In many instances the *exact* value of a resistor in a circuit is often not too important and you can substitute a resistor one value up or one value down from that specified without causing any great change in a circuit's operating conditions. For example; either a 2k7 or a 3k9 resistor may be substituted where a 3k3 value is specified. Don't do this with high wattage resistors or high stability resistors (1% or 2%). *Always*, a resistor having a smaller tolerance rating may replace one of a greater tolerance rating *of the same value*. For example; a 4k7, 10% resistor may be replaced by a 4k7, 5% type.

Similarly, half-watt resistors may be substituted for quarter-watt resistors, *provided* they physically fit.

Potentiometers

These are simply adjustable resistors. Commonly, they consist of a resistance 'track' with a movable 'wiper' connection that can be varied from one end of the resistance track to the other. Thus, they have three terminals.

This is where most newcomers come unstuck. The one in the middle is always connected to the wiper (shown as an arrow on the circuit symbol). This leaves the other two connections to sort out! On a rotary pot, with the shaft pointing at you and the terminals pointing at your feet, when the shaft is rotated clockwise (normal direction for 'up' or 'increase' – whatever the control is doing) the wiper will be heading for the right hand terminal. If it's a volume control, that'll be maximum volume and therefore the maximum signal point should connect to the right hand terminal. Got it?



The common potentiometer – a variable resistor. Terminal markings are standard for a volume control.

Even if you don't get it right in your project, it's easy to correct – simply reverse the connections to the two outer terminals!

The value and 'law' of the potentiometer required for a circuit will be specified with the project. It is not a good idea to substitute. The 'law' of the potentiometer simply refers to the way in which the resistance varies as you move the wiper. The two most common forms are 'linear' and 'logarithmic'. A linear law (or 'curve') pot changes its resistance in a manner directly proportional to the amount the wiper has been moved, whereas a logarithmic (or log) law pot varies resistance logarithmically as the wiper is moved linearly.

Log pots are predominantly used as volume controls. Linear pots are used for current or voltage control in circuits. A linear pot will be marked 'A', while a log pot will be marked 'C'.

Capacitors

Capacitors come in a wide variety of shapes, sizes, types and ratings. The important thing to remeber is that there are *polarised* and *non-polarised* types. *Electrolytic* and *tantalum* capacitors are *polarised* and you must take care which way round they are connected in a circuit. All the others are *non-polarised*. Of the latter, we mainly specify polyester (often referred to as "greencaps" as they're green) and ceramic types. These are the most common. They may be inserted either way round.

A polarised capacitor always has some marking or other to indicate which lead is which. Many are made with a black stripe adjacent to the negative lead. Some have a '+' and a '–' sign near the respective leads. Always check that you have inserted or connected polarised capacitors the right way round. They won't work otherwise – and that's about the worst that will happen in a battery-operated circuit. A wrongly-connected electrolytic in a mains-operated circuit (even at low voltages) may very well *explode*! Messy . . . worse if you have your face nearby when it happens.

In general, we have a small diagram near the circuit or wiring (construction) diagram indicating how to identify polarised capacitors.

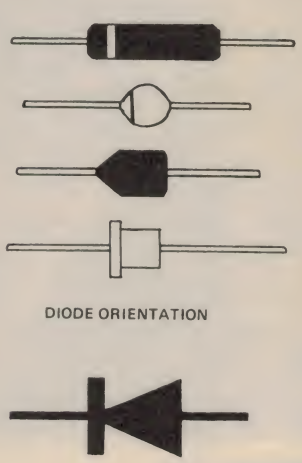
Variable (or tuning) capacitors come in an enormous variety of shapes, sizes, values, connections and applications. Where a tuning capacitor is used in any of our projects, specific details of how it is connected are always given with the construction diagrams or component overlay.

In general, capacitor values should be adhered to, substitution is not recommended unless you are very familiar with the way a circuit works and the role of the particular capacitor. Voltage rating is important, particularly with electrolytics and tantalums. You must *never* use a capacitor rated at a lower voltage than specified. You can go upwards, though. For example; if a project calls for a 10 μF, 16 V type then a 25 V rated capacitor of the same value may be substituted.

An article on capacitor marking codes and how to read them appeared in the May 1976 issue of ETI.

Diodes

Diodes are polarised components. There is *always* a right way and a wrong way



DIODE ORIENTATION

round. If you use it the wrong way round you may well destroy the device – particularly rectifier diodes in power supplies, and zener diodes. Fortunately, they always have some sort of mark identifying the cathode end. It may be a *band* around that end of the body adjacent to the *cathode* lead, or the body may be chamfered at that end. We generally indicate on the construction diagram with our projects the polarity of any diodes. Alternatively, a small diagram may accompany either the circuit or the construction diagram showing diode body shapes and markings and how these relate to the diode symbol.

Any substitutes will usually be mentioned in the parts list accompanying a project. However, as diodes are generally rated in terms of voltage (maximum reverse voltage, not conducting) and current (maximum forward current, when conducting), it is always safe to substitute a diode with one having higher ratings than specified – never the other way around. Never substitute a silicon signal diode for a germanium signal diode.

Transistors

For most purposes a transistor is either the right one or it's not. It is rarely possible to substitute another type which someone may recommend as 'just the same'. Usually, substitutes or ▶

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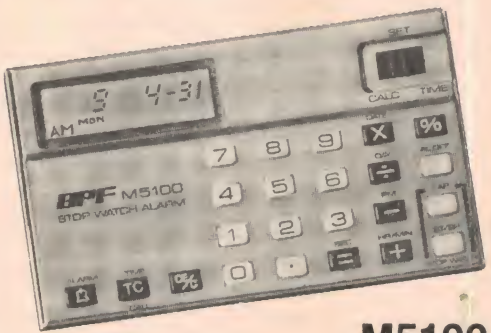

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equivalents will be mentioned in the parts list of a project.

A transistor can only be connected one way round — the right way! The construction diagram or component overlay with a project will indicate which way the pins are to be inserted in a pc board or otherwise connected. Connected incorrectly there's a good chance you'll destroy the device when first switched on.

Incredibly, not all transistors of the same type number have the same pin connection. Sometimes a manufacturer may vary the pin connections of a type at different times! Transistor pin connections and orientations are given in diagrams accompanying our projects, in general, especially where it may not be clear from the construction diagram or component overlay.

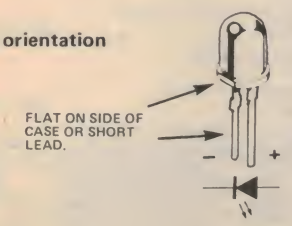
Transistors (and diodes) may be damaged by excessive heat when soldering. Although, these days, it is no longer really necessary to use a 'heatsink' (pliers or a special tool) when soldering small transistor leads — as has been often recommended in the past — a little care and speed when soldering is a good idea. Just get the solder flowing neatly over the joint, 'wetting' the joint properly, and things should be fine. Don't overdo it.

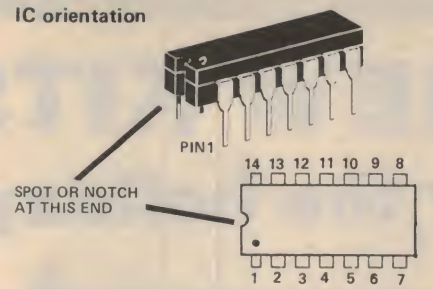
Integrated circuits

Integrated circuits must be soldered in the right way round. They always have some identification — usually in the form of a small scallop in one end of the case or a small identation adjacent to a pin at one end (this is pin 1). They should be inserted exactly as shown in our overlay drawings. Do make sure they are the right way round before soldering because once in they're very hard to get out again.

Because of this it's well worth while spending a bit more on any project which uses ICs to install IC sockets. These are little plastic sockets which have identical pin connections as the ICs and into which in turn the IC is plugged. It's not always worthwhile because some ICs are so cheap that the socket costs more than the IC, but they are worth considering for use with expensive devices.

Like transistors, most ICs are stronger than they look, but don't overdo the soldering — it's very easy





to get a tiny solder 'bridge' between the pins.

CMOS ICs are a bit different. These are very tough — once soldered in — but are a bit fragile until then.

They should be handled with care as they are easily damaged by quite small static charges. CMOS ICs are supplied inserted in a conductive plastic foam or foil-wrapped styrene block. Remove them carefully. Take care to pick them up with your thumb and forefinger grasping the ends of the package, not touching the pins. Make sure you have them correctly oriented before inserting them into a pc board.

When soldering CMOS ICs use an iron having an earthed tip and barrel. If you're unsure about this, use a clip lead to connect the iron's barrel to the negative supply rail on the pc board. These measures will ensure you don't 'blow' CMOS ICs from either static or leakage currents.

Always leave CMOS ICs until last when assembling a project. Once removed from the packaging, insert them in the pc board quickly and first solder those pins connected to the power rails — generally pins 7 and 14 for most 14-pin packages, but check with the diagram beforehand. This ensures any static charges are dissipated by the other components.

LEDs

Light emitting diodes are very handy little solid-state indicators and for that reason are widely used. Common colours are red, yellow and green although orange is available and we believe blue will be available shortly. Some are clear but glow red.

Being a diode they are polarised. They are not usually damaged if incorrectly connected — but they won't work. The polarity of the leads may be indicated in several ways. The most common is to have a *flat* section on the case adjacent to the *cathode* lead. Some have one lead shorter than the other — the *cathode* lead being the *shorter.*

cased correctly, LEDs will last forever. We don't know of any that have worn out yet! They must be used at the correct current rating. If this is exceeded . . . poof! You will generally find a resistor connected in series with a LED in a circuit. *Don't* ever test a LED by connecting it across a battery. Best way to test one is to wire it into a circuit known to work.

LED connection diagrams generally accompany the circuit or component overlay with our projects.

Loudspeakers

Small speakers are a common item in simple projects. In general, the unit chosen is not critical.

They are made in varying levels of quality, size and impedance. Quality is unimportant. Frankly we'd go for the cheapest you can find! Impedance is specified in each project parts list.

Speakers are not polarised — you may connect them either way round.

If the speaker doesn't make a noise when the project seems to work otherwise it's fairly sure you've got a dud one. Check by touching the leads momentarily across a 1½ volt cell NOT a nine volt battery. If the speaker is working it produces a loud click. Don't leave the cell connected for more than a fraction of a second or you'll end up knowing that the speaker was working but isn't any longer!

Conclusion

As a last caution, make sure you connect the battery or power supply to your project correctly, otherwise you may never know whether it worked or not! Most of our battery-operated projects use No. 219, 9 V batteries. The battery clips used with these have a red and a black lead for connections. The red one is the positive lead, the black, negative. This is the colour coding for supply connections. Keep it in mind.

That just about wraps up the majority of things you should learn and keep in mind when it comes to constructing basic projects. You will learn a whole host of other interesting, and useful, things as you progress with your hobby. The best teacher is experience, as they say in the classics. ●

If you boo-boo

If a circuit won't work the most probable causes of trouble in the most probable order of occurrence are:—

(a) Components inserted the wrong way round or in the wrong places.
(b) Faulty soldering.
(c) Bridges of solder between tracks
(d) Faulty components.

If all else fails write to us for help.

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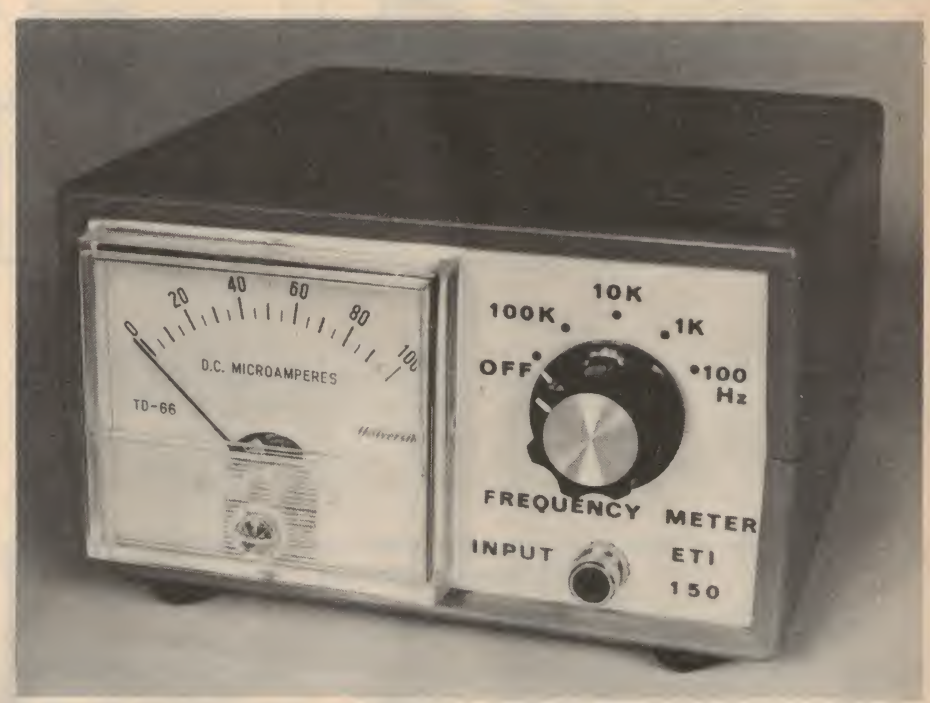
DSE652

Simple analogue frequency meter features linear scale

This simple project is easy to build, inexpensive and should find many uses in the hobby workshop.

Phil Wait



THERE ARE MANY applications in the home workshop where simple audio frequency measurements are required. When experimenting with oscillators, building or repairing function generators etc, it is often handy to have some means of measuring frequency — accuracy to the last Hertz is not always required and thus a full-blown digital counter is not warranted.

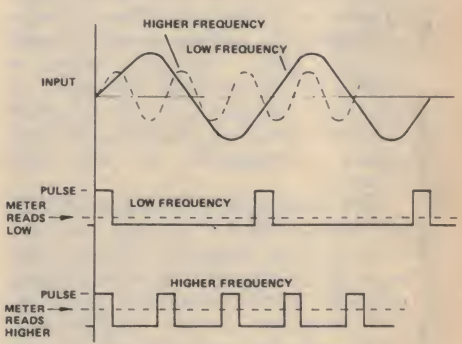
This project will enable you to measure frequency from around 100 Hz right up to 100 kHz with an accuracy of a few percent. It is inexpensive to build but performance is quite adequate to meet a large number of needs in any hobbyist's workshop. Accuracy is unaffected by the waveshape of the signal being measured and the unit will accept signal levels as low as 200 mV. The input is fully protected against high signal levels and against dc voltages up to the rating of the input capacitor, C1. The input is also fully floating above earth — a useful feature.

The frequency meter may be powered from an internal No. 216, 9 V battery or from a Plugpack battery eliminator. A suitable dc socket may be installed on the rear of the cabinet.

All components are readily obtainable, the moulded plastic case in which we housed the prototype is an item supplied by A & R Soanar and is available from many suppliers.

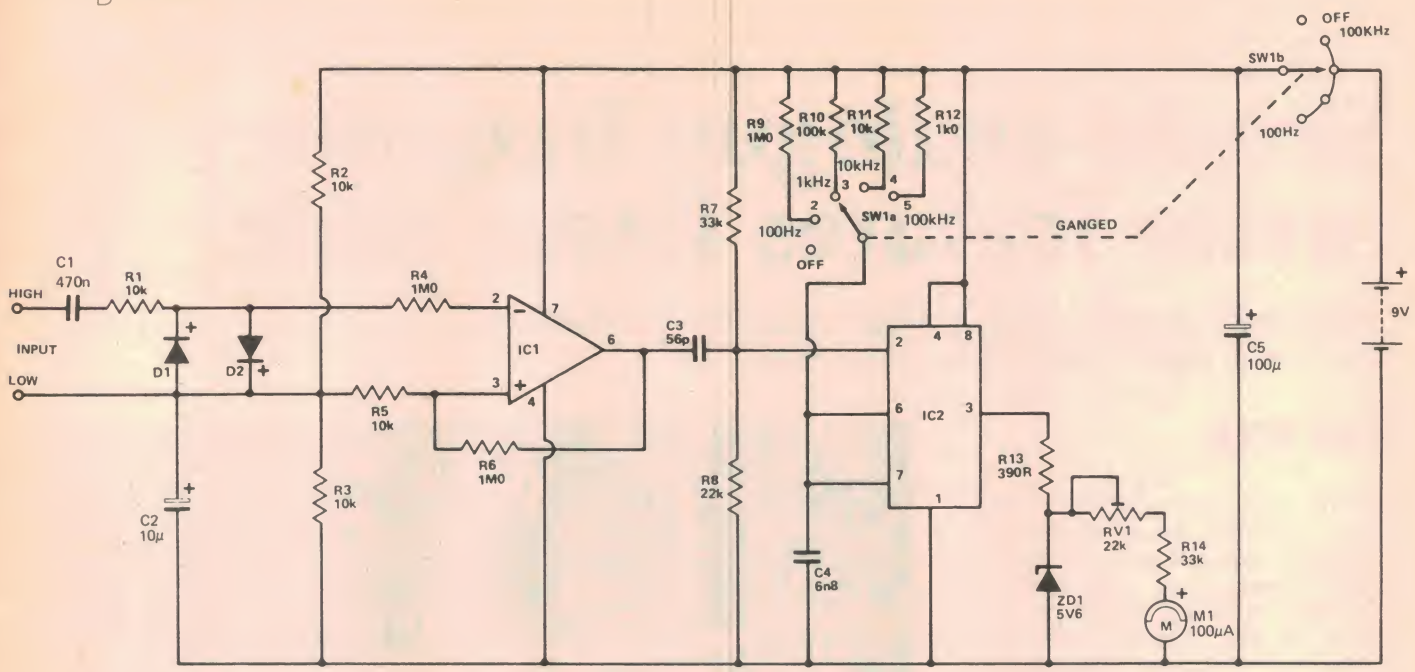
Circuit features

The circuit generates a series of short pulses at the same frequency as the input. These pulses drive a moving-coil meter the current through which will be the average amplitude of the pulse waveform; that is, it will integrate the pulses. This average will be proportional to the ratio of time the pulse is on to the time it is off. The time the pulse is on, that is — the pulse width, is fixed. At low frequencies, the time the pulse is off will be much, much longer than the time the pulse is on. Thus, the average current through the meter will be quite low. At higher frequencies, the time between pulses will be quite short and the average current through the meter will be quite a bit higher (As shown in the diagram). Thus, as the frequency of the pulses is proportional to the input frequency, the pulse on/off ratio, and therefore the meter current, will be proportional to the input frequency. The meter can be calibrated directly in frequency as the relationship is a linear one. We have used a 100 ▶



SPECIFICATIONS ETI 150

Frequency	10 Hz to 100 kHz in four decade ranges
Minimum input	200 mV RMS
Maximum input	250 V peak AC or DC (dependent on voltage rating of C1)
Supply voltage	9 Vdc battery or Plugpack battery eliminator



microamp movement for convenience as it does not have to be re-scaled. The lowest range is 100 Hz full-scale deflection, the highest, 100 kHz.

Only two cheap IC's are used in the whole design a 3140 op-amp and a 555 timer. The 3140 amplifies and squares the input signal and was selected for its high slew rate, wide frequency response and high input impedance. The output of this stage will be a square wave of the same level for all input signal levels and waveforms.

The pulses are generated by a 555 timer connected as a one-shot monostable giving a single pulse output for each input cycle. The monostable has four ranges giving decade scales on the meter. A fifth position on the switch is used as a power switch.

Regulation of the output pulses by a zener diode preserves the accuracy of the unit with falling battery voltage.

HOW IT WORKS – ETI 150

The circuit consists of an op-amp operated as a Schmitt trigger to amplify and square the input signal, followed by a 555 timer wired as a monostable, giving a short output pulse of fixed width for each cycle of input signal. This pulse drives a moving-coil meter, the reading being an average of the pulse amplitude, which is proportional to the pulse frequency. As the pulse frequency is directly related to the input frequency, the meter reading is directly proportional to the input frequency.

The input signal is coupled into IC1 via C1, which provides dc blocking. Protection from overload caused by high amplitude input signals is provided by a diode clipper consisting of D1, D2 and R1. The diodes are connected in an inverse-parallel arrangement so that both positive and negative peaks, above the diode forward conduction voltage, are clipped.

IC1 is a fast op-amp connected as a Schmitt trigger with amplification, as mentioned above. Resistors R5 and R6 provide hysterisis, a 'dead band' in the action of the Schmitt, centred on zero input level. This dead band ensures that the Schmitt ignores noise pulses.

As the unit is required to operate from a single supply, for convenience, R2 and R3 bias the input of IC1 at half the supply voltage.

The output of IC1 is a train of square waves at the same frequency as the input. The output of IC1 is differentiated to provide short trigger pulses for the 555 timer, IC2. The differentiating network consists of C3, R7 and R8. This network is arranged to provide a trigger pulse that is always shorter than the output pulse of the 555. Capacitor C3 is selected to give the shortest possible pulse to the 555 consistent with reliable triggering.

The output of the 555 monostable will be a pulse of fixed width, determined by the range resistors, R9 to R12, and capacitor C4. The ranges are arranged to give a 75% output duty cycle at frequencies of 100 Hz, 1 kHz, 10 kHz and 100 kHz on the input.

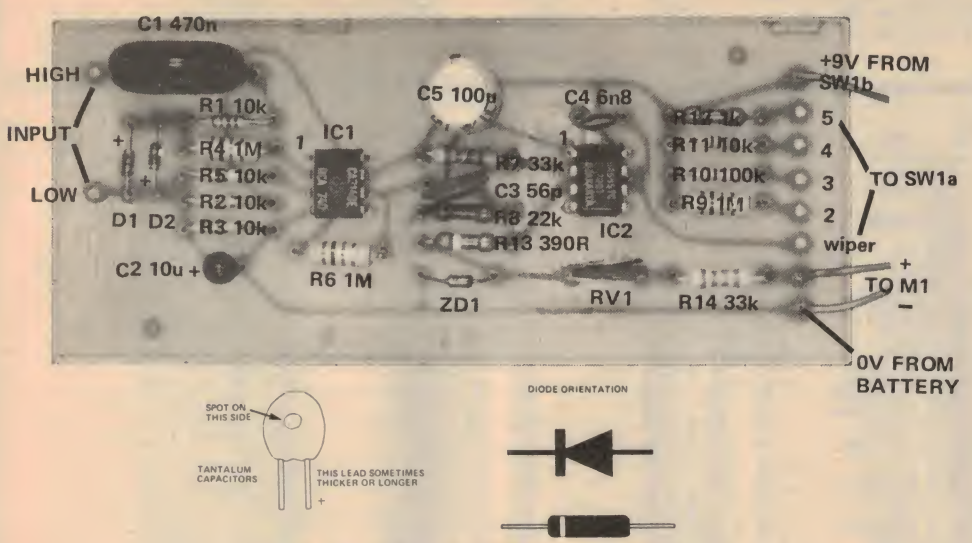
The output pulse from the 555 is clipped at 5.6 V by a zener diode, ZD1, to avoid inaccuracies caused by falling battery voltage (as the battery ages). The meter responds to the average value of the clipped pulses. As the frequency increases, the duty cycle (on/off ratio) of the pulse train increases, increasing the average voltage and thus the meter current in direct proportion. Thus the reading on the meter will be linearly related to frequency.

Construction

Even though this project is relatively simple, we strongly recommend you use the pc board – saves possible hassles!

As mentioned previously, we constructed our prototype in a commonly available plastic box. This has the advantage that the unit can be operated fully floating from earth – handy in some situations. Check placement of components on the front panel and the positioning of the pc board inside before commencing major assembly. It's probably best to assemble the components on the pc board first. Take care with the orientation of the ICs, diodes and tantalum capacitor.

The input capacitor, C1, can be obtained in several voltage ratings. Greencaps are available in ratings of 100 V, 250 V and 630 V. If all your work is with solid-state circuitry, a 100 V type will be more than adequate. If you anticipate using your unit with say, valve equipment, the highest rating type for C1 is recommended. The rating applies to the combined



The pc board pattern is on page 145.

dc voltage that may be present on the input, *plus* the possible peak value of the input signal.

A 630 V rated capacitor will be physically larger than a 100 V type and the leads may have to be shaped to fit the capacitor on the board.

Once the board is assembled, the major components can be assembled onto the front panel of the case. We made up a Scotchcal overlay for the front panel, to dress it up and give it a bit of a 'professional' look. Kit suppliers will probably have these available shortly after this issue goes on sale. Radio Despatch Service in Broadway, Sydney offer a special Scotchcal front panel service for projects so, if you are using a similar case you may have on hand, then they will be able to supply a front panel.

The meter, we used a University TD66 – but many other types are suitable, was mounted in a circular cutout on the left hand side of the panel. The range switch should be mounted next, followed by the input socket. After much discussion around the office ("A jack socket!", "No, screw terminals", "Rubbish! RCA socket" . . .), we settled on an RCA socket. It's a common item on audio equipment, inexpensive and coax cables terminated in RCA plugs, for input leads, are cheap and readily available.

However, any type of socket to suit your individual requirement will do equally well. If you use a metal box, the input connector earth must be the *only* connection from the circuitry to the case, as the negative rail from the battery is not at earth potential.

The pc board may be mounted anywhere convenient in the case and wires run to the front panel for the input and switch connections. Make sure the board does not get in the way of the meter when the front panel is in place.

The unit may be powered from an internal battery, which makes it a handy portable unit. If you wish to operate the unit from a plugpack battery eliminator, then we recommend you purchase a unit giving a nominal 6 Vdc output. The current requirement for the project is quite modest and the output of these small battery eliminators is dependent on the load. A 6 V unit will typically deliver 9 V or so under a light load.

If you do decide to use one of these units, a socket matching the unit's plug will have to be mounted on the rear panel and leads run to the supply rail pads on the pc board. If you wish to have the option of both battery and mains operation, then a small SPDT toggle switch should be mounted on the rear panel also and wired into the circuit.

Calibrating it

Calibration of the frequency meter is very easy, aided by the fact that it has a very high input impedance.

With the unit switched to the 100 Hz range, touch your finger to the input. There will usually be enough 50 Hz field from the electrical wiring in a building to drive the input. This will cause a deflection on the meter and RV1 should then be adjusted to give a meter reading of 50 (half scale). Move the unit near house wiring to increase the amount of signal to the input if a reading cannot be obtained.

If a signal generator of known accuracy is available the instrument can be calibrated on any range. Only one range need be calibrated as the others will automatically fall into line.

If it is impossible to obtain any reading on the meter, the coupling capacitor (C3) may have to be increased in value to say 100p or 150p. This component has been selected to give a very short trigger pulse into the 555 and has been found to work correctly, using the value shown in the circuit, with several different ICs.

Using your meter

Selecting the 100 kHz range will connect power to the unit and the unknown signal can then be applied to the input. the reading and switch to a lower range if required. This procedure avoids the possibility of spurious readings that may be obtained on lower ranges due to re-triggering of the 555 by high frequency signals. There are no other adjustments, so all you need is something to measure.

This is the sort of instrument that, once you have it, seems to find a great many uses for itself! ●

PARTS LIST - ETI 150

Resistors all ¼W, 5%
R1–R3. . . . . 10k
R4 . . . . . 1M
R5 . . . . . 10k
R6 . . . . . 1M
R7 . . . . . 33k
R8 . . . . . 22k
R9 . . . . . 1M
R10. . . . . 100k
R11. . . . . 10k
R12. . . . . 1k
R13. . . . . 390R
R14. . . . . 33k

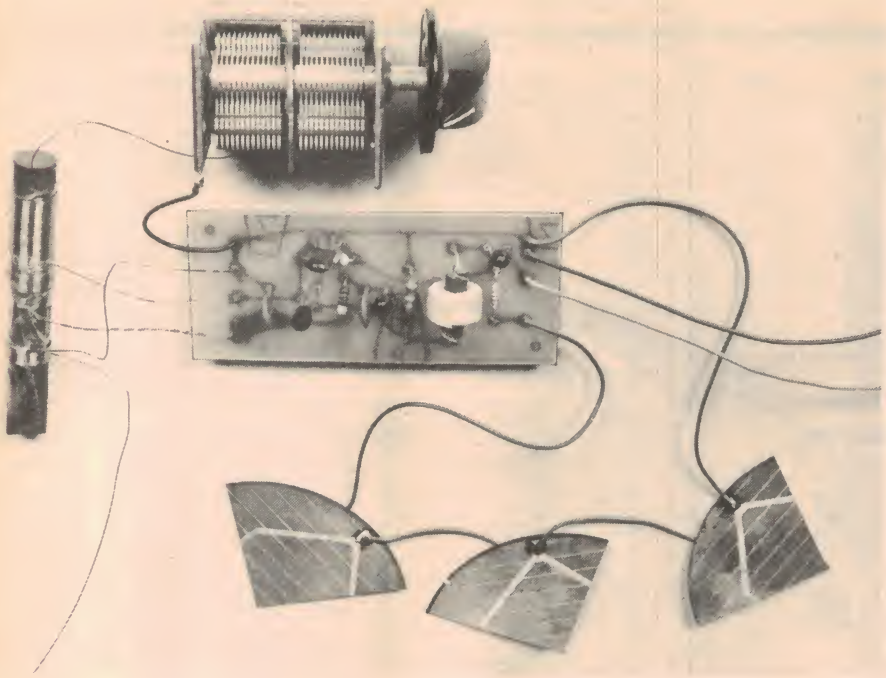
Capacitors
C1. . . . . 470n greencap
C2. . . . . 10µ tantalum
C3. . . . . 56p ceramic
C4. . . . . 6n8 greencap
C5. . . . . 100µ 25V electrolytic

Semiconductors
D1, D2 . . . . . 1N914 or similar
ZD1. . . . . 5V6, 400mW Zener diode

IC1 . . . . . 3140 op amp
IC2 . . . . . 555 timer

Miscellaneous
M1 . . . . . 100µA meter, University TD - 66 or similar
RV1 . . . . . 22k min vert mounting trim pot
SW1. . . . . two pole five pos wafer switch
Plastic box to suit (approx. 75 mm x 135 mm x 130 mm); input connector chassis mounting RCA socket or similar; knob, ETI 150 pc board.

ITEM	TRADE	INC. TAX
CMOS		
4000	.20	.23
4001B	.18	.21
4001A	.18	.21
4002	.19	.22
4006	1.05	1.21
4007	.21	.24
4008	.90	1.04
4009	.41	.47
4010	.42	.48
4011	.20	.23
4012	.19	.22
4013	.32	.37
4014	1.00	1.15
4015	.78	.90
4016	.41	.47
4017	.80	.92
4018	1.00	1.15
4019	.52	.60
4020	1.05	1.20
4021	1.05	1.20
4022	.95	1.09
4023	.18	.21
4024	.64	.73
4025	.19	.22
4026	1.40	1.61
4027	.42	.48
4028	.78	.90
4029	1.11	1.28
4030	.33	.38
4031	1.98	2.28
4034	3.25	3.74
4035	1.16	1.33
4039	.60	.69
4040	.92	1.06
4041	.90	1.04
4042	.64	.74
4043	.64	.74
4044	.61	.70
4046	.98	1.13
4047	1.06	1.22
4048	.45	.52
4049	.33	.38
4050	.37	.43
4051	.71	.82
4052	.70	.80
4053	.72	.83
4060	1.05	1.21
4066	.51	.57
4068	.29	.33
4069	.20	.23
4070	.34	.39
4071	.21	.24
4072	.34	.39
4073	.27	.31
4075	.24	.28
4076	1.05	1.21
4077	.29	.34
4078	.34	.39
4081	.23	.27
4082	.34	.39
4089	.90	1.04
4093	.50	.58
4503	.54	.62
4507	.40	.46
4510	.96	1.10
4511	.92	1.05
4512	.95	1.10
4514	2.20	2.53
4516	1.20	1.38
4518	.95	1.09
4519	.46	.53
4520	.92	1.05
4522	1.12	1.29
4527	1.05	1.20
4528	1.11	1.27
4529	1.45	1.67
4539	1.36	1.60
4541	1.40	1.61
4543	1.82	2.09
4553	6.15	7.08
4555	.90	1.04
MC1-4560	2.60	2.99
40097	.85	.98
40098	.85	.98
40175	.95	1.07
74C SERIES		
74C00	.22	.25
74C02	.22	.25
74C04	.22	.25
74C08	.22	.25
74C10	.22	.25
74C14	.40	.46
74C20	.25	.29
74C30	.25	.29
74C32	.25	.29
74C42	.98	1.13
74C48	1.34	1.54
74C73	.64	.74
74C74	.50	.58
74C76	.64	.74
74C83	1.25	1.44
74C85	1.10	1.27
74C86	.36	.51
74C90	.86	.59
74C93	.85	1.44
74C95	.55	.97
74C107	.60	.74
74C150	2.40	3.45
74C151	1.50	1.02
74C154	2.45	2.92
74C160	.80	.97
74C192	.84	.97
74C164	1.00	1.15
74C173	.95	1.09
74C174	.75	.86
74C175	.80	1.07
74C192	1.10	1.29
74C193	1.02	1.17
74C195	.90	1.04
74C221	1.30	1.50
74C373	1.60	1.84
74C374	1.82	2.09
74C901	.50	.58
74C902	.50	.58
74C905	9.80	11.27
74C906	.48	.55
74C907	.50	.58
74C915	.94	1.08
74C922	3.32	3.82
74C923	3.50	4.03
74C925	4.10	4.72
74C926	4.10	4.72
74C927	4.10	4.72
74C932	.95	1.19
80C SERIES		
MM80C95	.75	.86
80C96	.75	.86
MM80C97	.75	.86
80C98	.75	.86
LINEAR		
LH0002	7.50	9.56
LH0022CD	13.00	16.58
LH0042CH	4.43	5.65
LH0070	10.00	12.75
LH0071	10.00	12.75
REF02CJ	6.60	8.42
TL071	.68	.87
TL072	1.20	1.53
TL082	.88	1.12
LH0091CD	20.75	26.46
LH0094CD	29.50	37.62
SAK140	1.79	2.28
UAA170	2.80	3.57
UAA180	2.80	3.57
TCA220	1.80	2.30
LM301	.25	.32
LM301-H	.38	.49
LM304-H	1.40	1.79
LM305-H	.65	.83
LM307-CN	.32	.41
LM307-H	.75	.95
LM308	.60	.77
LM308H	1.00	1.27
LM310-N	1.75	2.23
LM310-H	2.10	2.68
311	.55	.70
LM311	.55	.70
LM311H	1.00	1.27
LM318	2.25	2.87
LM322	3.10	3.95
LM324	.63	.80
LM325	2.50	3.19
LM329-DZ	1.14	1.45
LM334Z	1.10	1.40
OM335	9.80	12.50
LM336Z	2.54	3.24
LM339	.50	.64
LM348	.92	1.18
LM349	1.45	1.85
LF351N	.55	.71
LF356AN	.90	1.15
LF357	.90	1.15
LM358	.60	.77
LM373	3.30	4.20
LM374	4.25	5.42
LM376	.56	.72
LM377	2.30	2.94
LM379	4.50	5.74
LM380 8PIN	.80	1.02
LM380 14PIN	.95	1.22
LM381A-N	1.95	2.40
LM381N	1.50	1.91
LM382N	1.30	1.66
LM383	2.15	2.74
LM384	1.95	2.49
LM386	.84	1.07
LM387	1.10	1.40
LM391	1.42	1.81
LM393	.70	.89
LF398	3.95	5.04
456P	1.29	1.64
NE530	.90	1.15
LINEAR		
555	.25	.32
556	.60	.77
LM565	1.10	1.40
LM565CH	1.65	2.10
NE566	1.95	2.49
LM567	1.20	1.53
NE571	7.50	9.56
TBA641BX1	2.00	2.55
TBA641B11	2.00	2.55
LM709-LN-8	.50	.64
LM709-14PIN	.62	.78
UA710CA	.54	.68
LM710-CH	.74	.94
711	.64	.82
UA711-H	.68	.88
UA716HC	4.95	6.31
723	.38	.49
LM723CH	.90	1.15
LM725	3.14	4.00
LM733	.98	1.25
UA739	1.60	2.04
741	.20	.25
LM741-H	.47	.60
UA747	.84	1.07
UA747HC	1.76	2.24
UA748	.42	.54
UA748HC	1.02	1.30
UA753	1.45	1.85
UA760HC	3.28	4.18
UA777	1.95	2.49
UA777HC	2.35	2.70
UA796HC	1.17	1.75
OM802	.94	1.20
SAB1048	4.20	5.36
LM1310N	1.90	2.43
1408	3.90	4.97
LM1458	.50	.64
UA1488	.74	.94
UA1489	.74	.94
MC1495	5.75	7.33
MC1496L	1.23	1.42
LM1558	1.23	1.57
LM1596	1.15	1.47
LM1830	2.50	3.19
2719	3.50	4.03
LM2902	1.20	1.53
LM2917 8PIN	2.25	2.87
LM2917	2.45	3.12
CA3028	1.43	1.82
LM3039	.78	.99
CA3046	1.36	1.73
3065	.40	.50
LM3080	.96	1.22
LM3089	3.13	3.99
CA3130T	1.05	1.40
CA3130E	1.42	1.80
CA3140	1.05	1.40
3401	.60	.77
3611	.92	1.17
LM3900	.65	.83
LM3909	.85	1.08
LM3914N	3.10	3.95
4136	1.48	1.88
LM4250	1.45	1.80
UA4558TC	1.08	1.42
MM5837	1.18	1.50
LM7555	1.47	1.87
MC10116L	.79	1.00
LF13741	.50	.64
LF13741-H	.61	.78
DS75452	.45	.57
76477	3.53	4.50
TTL (S)		
74S00	.30	.35
74S02	.30	.35
74S04	.74	.85
74S10	.70	.80
74S11	.70	.80
74S32	.70	.80
74S51	.70	.80
74S74	1.13	1.30
74S86	1.17	1.45
74S112	1.13	1.30
74S135	2.00	2.30
74S138	2.87	3.30
74S157	2.61	3.00
74S158	2.61	3.00
74S182	2.87	3.30
7400 SERIES		
7400	.16	.18
7401	.18	.20
7402	.14	.16
7403	.18	.20
7404	.16	.18
7405	.22	.25
7406	.18	.20
7407	.30	.35
7408	.16	.18
7409	.20	.23
7410	.14	.16
7411	.23	.26
7412	.26	.30
7413	.30	.35
7414	.32	.37
7416	.30	.35
7417	.40	.46
7420	.17	.19
7421	.18	.20
7423	.35	.40
7425	.40	.46
7426	.26	.30
7427	.30	.35
7430	.17	.19
7432	.25	.29
7437	.30	.35
7438	.30	.35
7440	.20	.23
7441	.90	1.04
7442	.40	.46
7443	1.30	1.50
7444	1.20	1.38
7445	1.00	1.15
7446	.84	.97
7447	.64	.74
7448	.83	.95
7450	.18	.20
7451	.18	.20
7453	.20	.23
8T26	.65	1.85
9300	.60	.69
9307	1.60	1.84
9308	1.12	1.29
7454	.18	.20
7470	.35	.40
7472	.32	.37
7473	.32	.37
7474	.26	.30
7475	.25	.29
7476	.26	.30
7480	.60	.69
7482	1.60	1.84
7483	.74	.85
7485	.75	.86
7486	.36	.42
7489	1.42	1.63
7490	.25	.29
7491	.52	.60
7492	.36	.41
7493	.26	.30
7494	.80	.92
7495	.40	.46
7496	.70	.81
7497	2.20	2.53
74107	.40	.46
74109	.32	.37
74116	1.90	2.19
74121	.40	.46
74122	.60	.69
74123	.58	.67
74125	.52	.60
74126	.55	.63
74132	.75	.86
74141	1.04	1.20
74145	.80	.92
74147	1.78	2.05
74148	1.24	1.43
74150	.65	.75
74151	.36	.41
74152	4.42	5.01
74153	.65	.75
74154	.65	.75
8T28	1.40	1.61
9310	.60	.69
9311	.90	1.03
9312	1.20	1.38
74155	.86	.99
74156	1.38	1.59
74157	.56	.64
74160	.92	1.06
74161	.95	1.09
74162	.85	1.01
74163	.80	.92
74164	.55	.63
74165	.55	.63
74166	1.28	1.47
74167	2.20	2.53
74170	1.83	2.11
74173	1.45	1.67
7400 SERIES		
74174	.48	.55
74175	.84	.97
74176	1.04	1.20
74177	1.00	1.15
74180	.84	.97
74181	2.08	2.39
74182	.84	.97
74184	1.90	1.29
74185	1.90	1.29
74190	.90	1.04
74191	.80	.92
74192	.65	.75
74193	.72	.83
74194	1.05	1.20
74195	.60	.69
74196	.80	.92
74197	.99	1.13
74198	.99	1.13
74199	1.20	1.38
74221	.80	.92
74290	.80	.92
74293	.80	.92
74365	.75	.86
74366	.75	.87
74367	.55	.63
74368	.74	.85
8T96	1.65	1.89
9314	1.20	1.38
9368	1.70	1.96
9370	1.80	2.07
74LS00	.16	.18
74LS01	.20	.23
74LS02	.15	.17
74LS03	.19	.22
74LS04	.19	.22
74LS05	.20	.23
74LS08	.18	.20
74LS09	.19	.22
74LS10	.18	.20
74LS11	.20	.23
74LS13	.40	.46
74LS14	.60	.69
74LS15	.25	.29
74LS20	.20	.23
74LS21	.21	.24
74LS22	.22	.25
74LS26	.26	.30
74LS27	.21	.24
74LS28	.30	.35
74LS30	.22	.25
74LS32	.21	.24
74LS33	.32	.37
74LS37	.30	.35
74LS38	.26	.30
74LS40	.20	.23
74LS42	.70	.81
74LS47	.80	.92
74LS48	.96	1.10
74LS49	.96	1.10
74LS51	.24	.28
74LS54	.24	.28
74LS55	.50	.58
74LS58	.60	.69
74LS73	.50	.58
74LS74	.31	.36
74LS75	.40	.46
74LS76	.36	.41
74LS78	.36	.41
74LS83	.91	1.05
74LS85	.90	1.04
74LS86	.30	.35
74LS90	.44	.50
74LS92	.84	.96
74LS93	.54	.62
74LS95	.62	.71
74LS96	1.40	1.61
74LS107	.34	.39
74LS109	.34	.39
74LS112	.34	.39
74LS113	.60	.69
74LS114	.48	.55
74LS122	.42	.48
74LS123	.71	.82
74LS125	.44	.51
74LS126	.65	.75
74LS132	.74	.85
74LS133	.30	.35
74LS136	.34	.39
74LS138	.64	.74
74LS139	.80	.92
74LS151	.68	.78
74LS153	.56	.64
74LS154	1.32	1.52
74LS155	.96	1.10
74LS156	.96	1.10
74LS157	.86	.99
74LS158	.66	.76
74LS160	.78	.90
74LS161	.78	.90
74LS162	.95	1.09
74LS163	.78	.90
74LS164	1.16	1.33
74LS165	.48	.55
74LS168	1.70	1.96
74LS169	1.70	1.96
74LS170	2.46	2.83
74LS173	.66	.76
74LS SERIES		
74LS174	.64	.74
74LS175	.64	.74
74LS181	2.50	2.88
74LS189	3.35	3.85
74LS190	1.20	1.38
74LS191	1.02	1.17
74LS192	.82	.94
74LS193	.82	.94
74LS194	.65	.75
74LS195	.75	.86
74LS196	1.15	1.32
74LS197	.96	1.10
74LS221	1.02	1.17
74LS245	2.10	2.42
74LS247	.80	.92
74LS249	1.15	1.32
74LS251	.70	.81
74LS253	.95	1.10
74LS257	.60	.69
74LS258	.45	.52
74LS259	2.20	2.53
74LS260	.35	.40
74LS266	.66	.76
74LS273	1.70	1.96
74LS279	.60	.69
74LS283	1.10	1.20
74LS90	.99	1.13
74LS293	1.05	1.21
74LS295	1.50	1.70
74LS298	.95	1.10
74LS352	1.15	1.32
74LS353	1.15	1.32
74LS365	.48	.55
74LS366	.66	.76
74LS367	.53	.61
74LS368	.36	.41
74LS373	1.30	1.50
74LS374	1.50	1.73
74LS386	.46	.53
74LS670	2.38	2.74
81LS95	2.11	2.42
95H90	7.74	8.90
11C90	11.44	13.15
81LS96	2.11	2.42
81LS97	2.11	2.42
81LS98	2.11	2.42
TRANSISTORS		
2N301	1.80	2.30
2N657	.14	.18
2N930	.51	.65
2N1613	.90	1.15
2N1711	.45	.58
2N1893	.86	1.10
2N2219A	.35	.47
PN2222	.18	.24
2N2222	.25	.32
2N2483	.30	.39
2N2484	.54	.69
2N2646	.55	.70
2N2647	.90	1.15
2N2894	.68	.87
2N2904	.40	.51
2N2905	.35	.45
2N2906	.30	.50
PN2907	.24	.30
2N2913	1.00	1.28
2N3053	.35	.38
2N3054	.60	.77
2N3055	.49	.63
2N3301	.25	.32
2N3440	.94	1.20
2N3502	.60	.77
2N3503	.60	.77
2N3563	.18	.23
2N3564	.23	.29
PN3565	.18	.23
PN3566	.15	.20
PN3567	.18	.23
PN3568	.18	.23
2N3569	.18	.23
2N3638	.18	.23
2N3639	.18	.23
2N3640	.18	.23
2N3641	.18	.23
PN3642	.14	.18
PN3643	.16	.20
PN3644	.16	.20
2N3645	.16	.20
2N3646	.16	.20
2N3692	.43	.55
2N3693	.30	.38
PN3694	.10	.13
2N3702	.20	.26
2N3704	.25	.32
2N3709	.25	.32
2N3713	1.66	2.22
2N3771	1.50	1.91
2N3772	1.50	1.91
2N3819	.25	.32
2N3866	1.62	2.07
2N3904	.18	.23
2N3906	.16	.20
2N4030	.90	1.15
2N4032	.45	.57



A solar-powered 'reflex' receiver

Simple, yet cunning, this circuit technique is actually quite old. Good fun to build, too!

FOLLOWING the crystal set era, came the valve radio era. It lasted some thirty years. As times were tough in the 1930s, when the valve era began, hobbyists had to make the best of every hard-won component. As a valve was just about the single most expensive item, one-valve radio receivers enjoyed enormous popularity.

Here's a modern version. Just one transistor and a handful of components. Not much more to it than a crystal set!

How it works

This simple but very sensitive radio uses a 'reflex' circuit, where the radio station signal is passed through the transistor and amplified at radio frequency, detected, then passed through the transistor once more for audio frequency amplification.

This circuit can operate at very low voltages, which makes it ideal for use with solar cells. In fact only three cells in series giving about 1.2 V, will power this radio.

Signals picked up by the antenna are coupled into the coil of the tuned circuit via a 'link' — several turns of wire near one end. The desired station is selected by varying the tuning capacitor — which varies the resonant frequency of the coil/tuning capacitor combination. Another link winding, coupled into the coil of the tuned circuit, picks up the RF energy from the selected station, passing it to the base of transistor for amplification and detection.

To understand reflex operation of the transistor, let's look at what happens to inductors and capacitors at different frequencies. Two vastly different frequencies pass through this circuit. The radio frequency is between 500 kHz and 1600 kHz while the audio frequencies lie between about 20 Hz and 5 kHz.

Capacitors and inductors have what's called 'impedance'. This is the term given to the resistance of the inductor or capacitor to the passage of an ac current. Inductors and capacitors behave as opposites. As the frequency *increases* the impedance of an inductor *increases* but the impedance of a capacitor *decreases*. An inductor can be chosen to prevent high frequency signals (RF) from passing through but still allow low frequency (audio) signal to pass.

Conversely, a capacitor may be chosen to allow high frequency signals (RF) to pass but block low frequency (audio) signals.

So impedance increases with frequency in an inductor and decreases with frequency in a capacitor. The value of the impedance at any one frequency depends on the value of the inductance, (henrys, millihenrys etc) and the capacitance (nanofarads, microfarads etc). Thus, inductors and capacitors can be used to separate two signals if they are vastly different in frequency.

Now, let's look at our circuit again. The RF signal has been applied to the base of the transistor and appears, amplified, at the collector. The signal is still RF and will not pass through the radio frequency choke because it has a high impedance at these frequencies. It can, however, pass through the 10 nF capacitor, which has a low impedance at RF, to the diode detector. The diode rectifies the signal, leaving half-wave RF pulses which vary in amplitude with the superimposed audio from the station. The RF is then removed by shorting it to ground through a capacitor having a low impedance at RF but a high impedance at audio, leaving only the low frequency audio waveform. This is exactly the same detection process as used in our crystal sets and the process is the same in all but the most complex receivers.

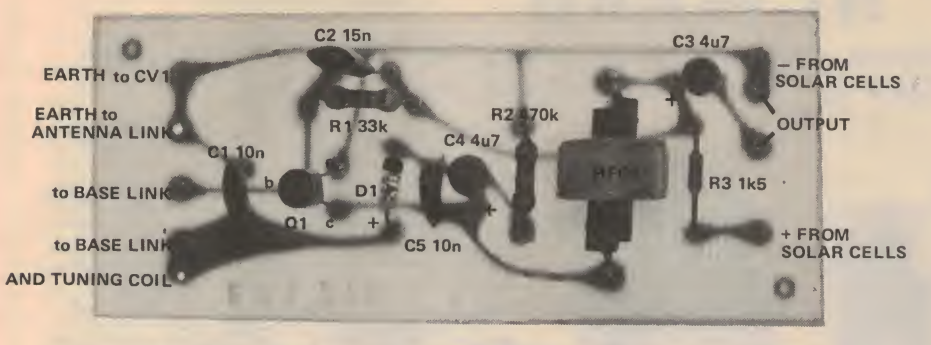
Now the audio signal from the detector is passed through the link winding of the coil to the base of the transistor. The link has no effect on the audio as it has a low impedance. The audio signal is then amplified and appears on the collector but this time, because of the low impedance of the RF choke to audio frequencies, the audio appears across the collector load resistor (R2) and is passed through to the output.

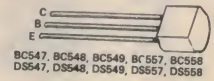
The single transistor does double duty, first amplifying the RF signal, then the audio signal. Pretty nifty, eh?

Construction

We decided to build this radio on a printed circuit board to simplify the construction.

The coil requires a little care but is not as mysterious as some people tend to think. In fact even the sloppiest coils can work perfectly. A ferrite rod is used which reduces the size of the coil





required. Compare the size of this coil to those used in the crystal sets.

Wind the tuning coil first and hold it in place with a small amount of Araldite or quick-setting glue. The turns must be 'closewound', next to each other. Next, wind the base link over the top of the tuning coil at the one end. Hold this winding in place with Araldite or glue also. The adjacent ends of each coil should be twisted together and joined at the printed circuit board. The antenna link can be wound anywhere on the ferrite rod as its signal is coupled through the ferrite to the tuning coil. Once all windings are finished make sure they are rigidly held in place.

We used a readily available tuning gang, but any gang from an old radio will do equally as well. If you have a dual-gang capacitor, only use one section.

The solar cells are brittle, so take care. The terminal uppermost in the photo is the negative terminal. Solder quickly, but carefully.

We have left the mechanical construction up to you as so many possibilities exist. The only limitation is that if housed in a box it should be plastic or wood if an antenna is not used, and the solar cells should be mounted where they get the most light. And, as solar power is free, a switch is unnecessary.

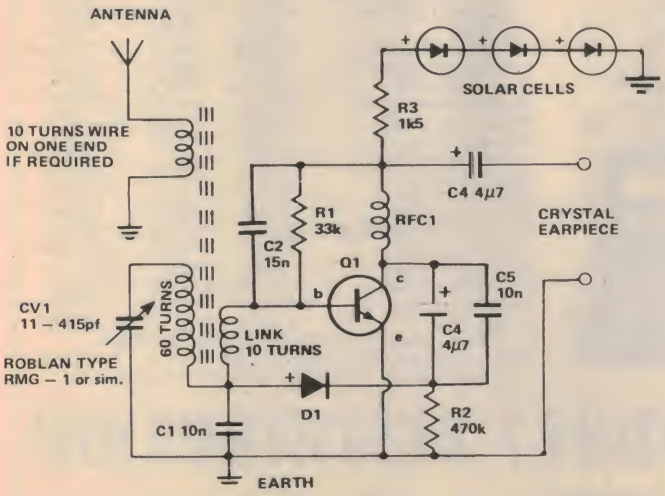
Using it

This radio makes very efficient use of its transistor and can give surprisingly good results. In areas close to stations an antenna will not be necessary and only short antennas will have to be used in most areas. In fact, if the antenna is too long the audio may sound distorted as strong signals can overload the transistor.

A good idea may be to have two antennas – one just a few feet long for local stations and the other quite long for distant stations. The best way to find out what you need is to experiment a little. Generally, an earth will not be necessary, but try one anyway. Details are given with the crystal sets.

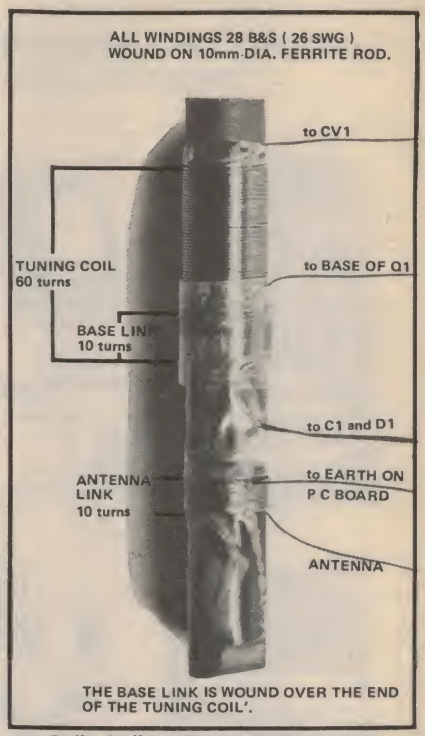
As the radio is powered by solar cells, some light is essential. We found, using three cells, the radio would burst into life in quite low light levels.

If you want to use it at night, when distant stations can usually be heard, disconnect the solar cells and use a 1.5 V battery.



This circuit has been designed for the maximum possible gain. If you find that the circuit begins to oscillate, reduce the number of turns on the base link winding from ten to , say, eight turns.

The pc board pattern is on page 145.



Coil winding and connection details (shown actual size).

Although most artificial lighting will operate the radio it will misbehave with fluorescent lighting. If you try it you will hear a buzz because these lights are 'modulated' by the ac mains current giving rise to the raw 50 Hz buzz. A 1000 µF, 6 V electrolytic across the supply connections should fix that. ●

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Resistors all ½W, 5%
R1 . . . . . 33k
R2 . . . . . 470k
R3 . . . . . 1k5

Capacitors
C1. . . . . 10n greencap
C2. . . . . 15n greencap
C3, C4 . . . . . 4µ7 10V electrolytic
C5. . . . . 10n greencap

Semiconductors
D1 . . . . . OA90, OA91, OA95, OA202 or similar germanium diode
Q1 . . . . . BC108, BC548, DS548, 2N3565, 2N3564 or similar

Miscellaneous
Coil . . . . . see text
CV1. . . . . tuning gang, 10 - 400p approx, Roblan type RMG1 or similar - see Shoparound, p.83
Solar cell . . . . Sensor Technology C202; Dick Smith Cat. No. Z-4820 or similar - see Shoparound, p.83
RFC1. . . . . 1 mH - 5 mH RF choke
pcb . . . . . ETI 270

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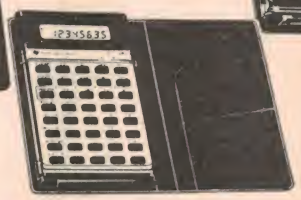

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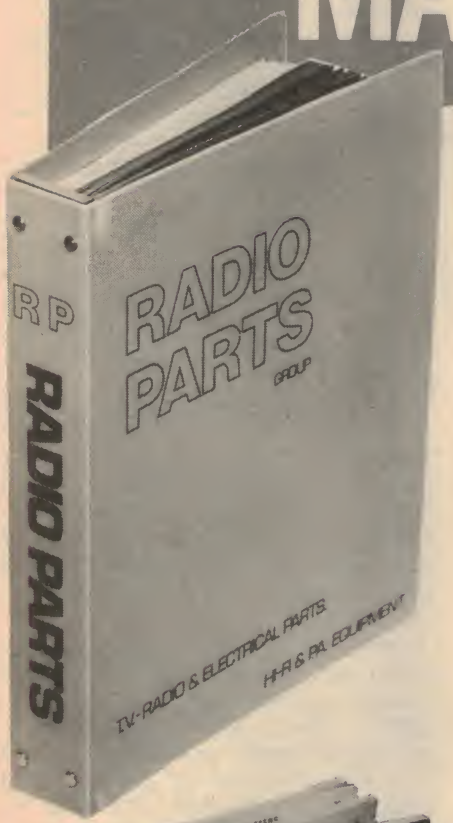

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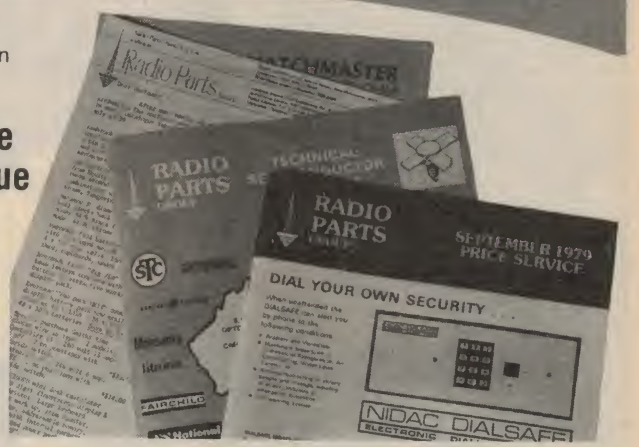

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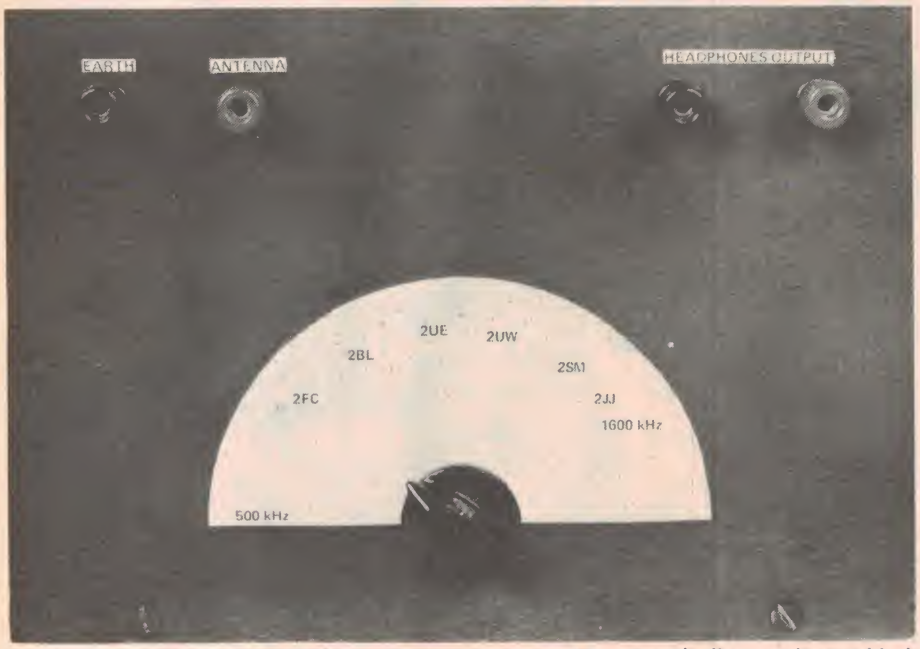
Two crystal sets to build

The crystal set was once every radio/electronics hobbyist's 'starter' project. Perhaps it should be returned to its former popularity. Beginner or not, try these two now.



We built our crystal sets on a chipboard base with plywood front panel, all sprayed matte black.

"IN MY DAY", said the old timer in his quavering rasp, "we built crystal sets with spider-wound coils and galena-and-catswhisker crystal detectors and listened to the stations on 2000 ohm Brown's headphones".

In deference to the old gent, we won't mention the era but that was a pretty hot-shot (read 'sophisticated') set-up in his day.

Modern beginners in electronics are more likely to cut their teeth on a project that includes at least one integrated circuit or a handful of transistors plus the usual resistors and capacitors.

Some hobbyists subscribe to the view that, if you haven't built a crystal set (*and* got it going!), then you haven't *lived.*

How it works

The crystal set basically consists of a tuned circuit, which selects the wanted station, and a detector, which separates the sound (music, speech etc) from the radio transmission, producing an audio voltage which is then impressed on the earpiece or headphones. This audio voltage is an exact copy of the sound from the radio station which has been superimposed on the radio signal at the transmitter.

The aerial receives all the electromagnetic radiation (radio waves) in your area. These signals have to be separated somehow, and the one station you're interested in must be sorted out from the mess otherwise, the signal will be hopelessly lost in the scramble of thousands of stations.

To select one station at a time we use a tuned circuit consisting of a coil of wire connected to a tuning capacitor. Signals picked up by the antenna cause the tuned circuit to 'resonate'. That is, signal currents close to a particular frequency will be greatly magnified, while those away from that frequency will be reduced, or attenuated.

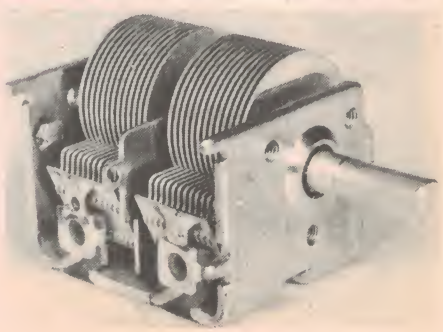
In our tuned circuit the frequency of resonance is determined largely by the number of turns on the coil, its diameter, and the value of the tuning capacitor. One way to tune the circuit over a range of frequencies is to use a fixed coil and make the capacitor variable. This is what we have done as components are convenient and readily obtainable. The variable capacitor enables us to tune the frequency range of interest, about 550 kHz to 1.6 MHz. Increasing the capacitance (plates more in mesh) decreases the resonant frequency; with the plates more out of mesh (less capacitance) the resonant frequency is increased.

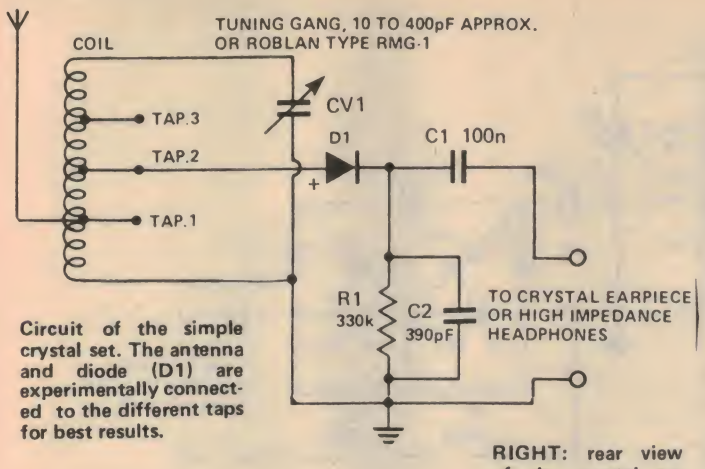
Now different stations can be selected, removed from the mess, and passed on to the detector. The size of the coil and the range of the capacitor must be selected to give a frequency coverage over the range of stations that you want to listen to.

Since tuned circuits are not perfect — nothing ever is in electronics! — frequencies close to the resonant frequency are also passed to the detector. The ability of a tuned circuit to select only one frequency is called its 'selectivity'. Our crystal set has a rather poor selectivity, but it's adequate for our purposes.

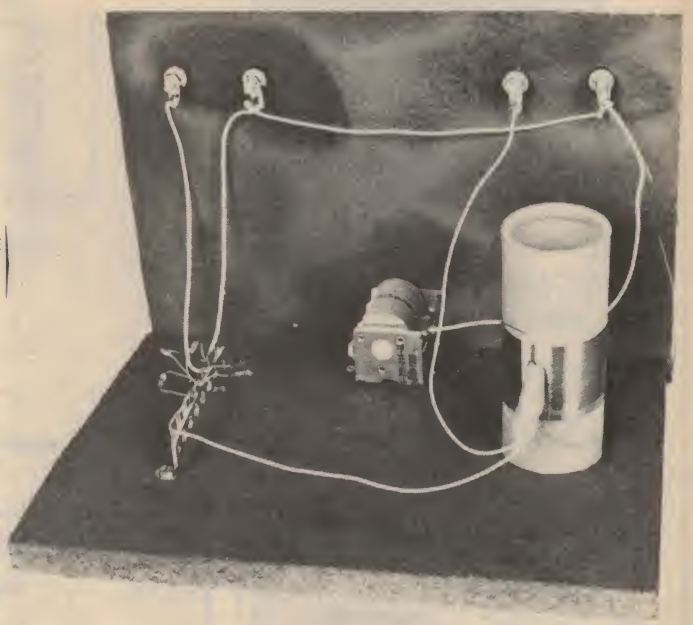
After the signal has been selected it is fed to the diode detector. At this point it is a high frequency radio signal, called a carrier, with the audio (music etc) superimposed or 'modulated' onto it. If this signal was fed directly to an earpiece, nothing would be heard as the earpiece cannot respond to the radio frequency signal. The diode "rectifies" the signal, leaving a half-wave radio signal which varies in amplitude with the audio signal. The fixed capacitor

Dual-gang tuning capacitors like this one are the most commonly available type. Only one section is used for these projects. The fixed plates are insulated from the frame and connection is made to the terminal on the side (either one). The earth connects to the frame.





Circuit of the simple crystal set. The antenna and diode (D1) are experimentally connected to the different taps for best results.



RIGHT: rear view of the crystal set showing placement of components and interconnections.

The dial on the front panel was cut from cardboard and lettered with rub-down lettering (see opposite page).

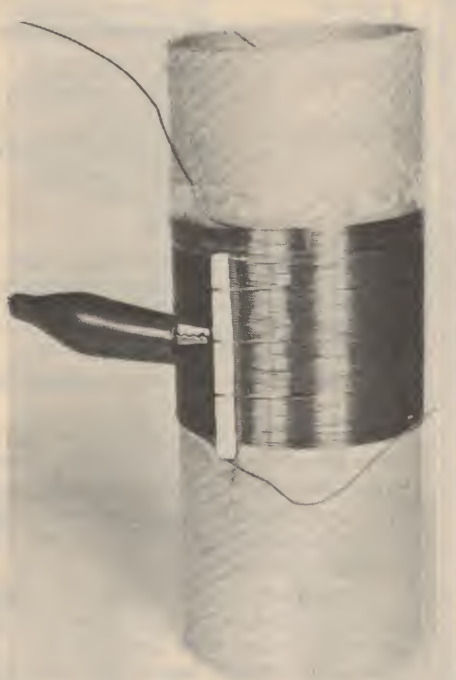
from the diode to earth 'shorts out' or 'bypasses' the RF signal, leaving the audio which is then fed to the earpiece.

In the first circuit, a single diode is used which gives good results, especially in areas with a local station, and is very easy to construct. The second circuit uses a more complex 'voltage multiplier' detector. This multiplies the signal level by four, increasing the volume in the earpiece. This circuit is commonly seen in high voltage power supplies.

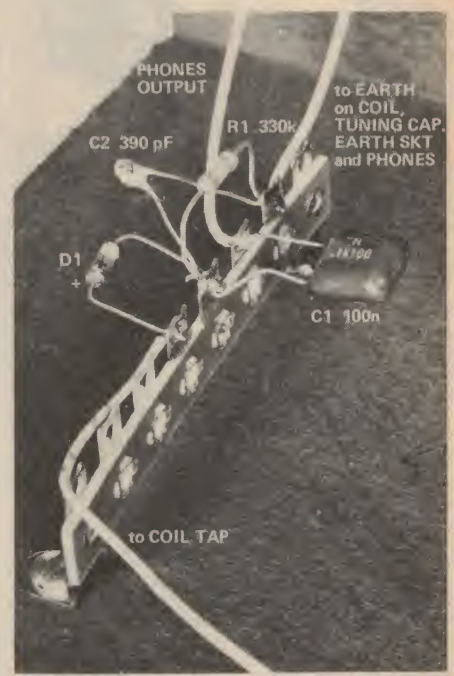
Construction

We built our two crystal sets on a chipboard base fitted with a plywood front panel. The tuning knob, terminals for the antenna and earth, and the earphone socket are mounted on the front panel.

The tuning capacitor we used was a common type available from most suppliers. This is the most expensive part in the set and a variable capacitor from a discarded mantle or floor-model radio will do equally as well. Some tuning capacitors may have two sections. If you obtain one of these 'dual-gang' capacitors, only use one section. ▶



We wound the coil for these projects on a former cut from a cardboard mailing tube. The matchstick is slid under each of the turns to be tapped. Clean the enamel from the wire at each tap to get a good connection.



The components for our simple crystal set were mounted on an eight-lug tag strip screwed to the baseboard.

PARTS LIST - ETI 266

R1 . . . . . .330k ½W, 5% resistor

C1. . . . . .100n greencap capacitor
C2. . . . . .390p ceramic capacitor

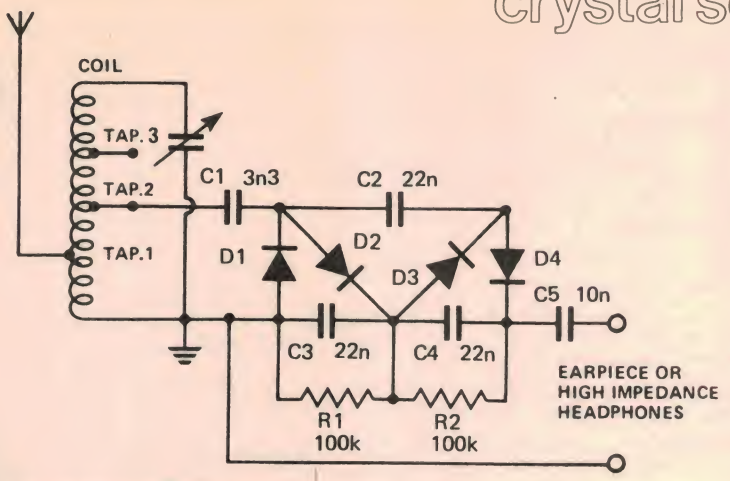
CV1. . . . . tuning gang approx. 10-400p, Roblan type RMG1 or similar, see Shop-around, p. 83.
D1 . . . . . OA90, OA91, OA95, OA202 or similar germanium diode
Coil. . . . . see text

Crystal earpiece or *high impedance* headphones; miniature jack socket to suit earpiece or terminals to suit headphones; screw terminals for aerial and earth connections; base board and front panel (see text).

TABLE 1

NUMBER OF TURNS FOR WIRE GAUGE

COIL DIA.	22 SWG	24 SWG	26 SWG	28 SWG	TAPS
30 mm				110	at ¼, ½ and
40 mm			96	90	¾ of the turns.
45 mm		88	80	70	You may tap
50 mm	82	72	68	60	every ten turns
55 mm	71	64	60	52	if you wish
65 mm	61	56	54	47	for more range
70 mm	54	52			of adjustment.



The voltage-multiplier crystal set provides more volume in your earphones.

PARTS LIST - ETI 267

R1, R2 . . . . . 100k ½W, 5% resistor

C1. . . . . 3n3 ceramic capacitor
C2–C4 . . . . . 22n ceramic capacitor
C5. . . . . 10n greencap capacitor

D1–D4. . . . . OA90, OA91, OA95, OA202 or similar germanium diode
CV1. . . . . tuning gang, approx. 10-400p, Roblan type RMG1 or similar, see Shop-around, p.83.
Coil . . . . . see text

Crystal earpiece or *high impedance* headphones; miniature jack to suit earpiece or terminals to suit headphones; screw terminals for aerial and earth connections; base board and front panel (see text).

Various coil sizes can be used and we have given a table for different former sizes and wire gauges. All these coils will work equally well on formers made of cardboard, plastic or wood. We used a cardboard mailing tube.

Winding the coil is easy, but rather tedious. Anchor the wire at one end of the former with adhesive tape, or threaded through two holes, and start winding. The coil must be 'tapped' at ¼, ½, and ¾ of the winding. To do this, slide a piece of match stick under the turn to be tapped to raise it above the other turns, as shown in the photo. When the coil is finished, fasten the end as you did the start. You could coat the ends with five minute Araldite to hold the windings in place. Carefully scrape the enamel off the wire at the tapping points.

The other components can be mounted on a tag strip, as we have done, and flying leads with small alligator clips taken to the tapping points on the coil.

Getting them going

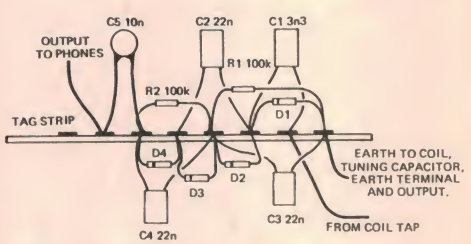
The performance of your crystal set will depend on the length and height of the antenna and the distance from the station. Remember, crystal sets are very crude devices compared to modern radios, and require long antennas, especially if you live a long way from a station.

An antenna can be made by running a long wire from the eaves of your house to a tall tree or mast, as shown in the accompanying illustration. The wire can be any gauge as long as it can support itself, and can be insulated or uninsulated. NEVER run an antenna wire near or above mains electricity wires.

An 'earth' usually helps reception. This can be provided by driving a metal stake into the ground to a depth of about one metre or attaching a wire to the house water pipes. NEVER attach an earth to a gas pipe or the house wiring earth.

The optimum position for connecting the antenna and diode to the taps on the coil is best found by experiment and will be affected largely by the size of the antenna.

Have fun with your crystal sets! ●



As with the simple crystal set, we mounted the components for the voltage-multiplier crystal set on an eight-lug tag strip. We have supplied a drawing as it is clearer than a photo in this instance.

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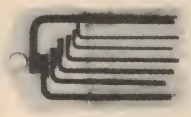

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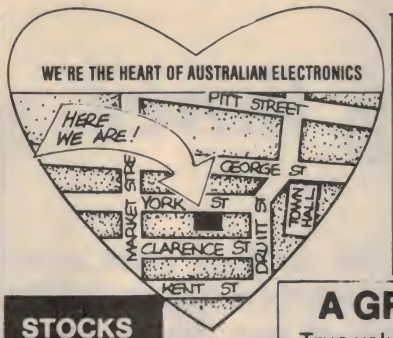

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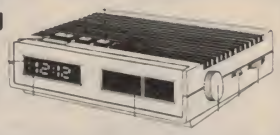

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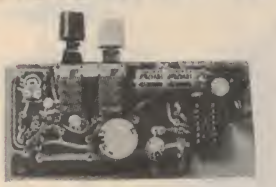

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A simple egg timer

Delay timers, as illustrated in this project, have a wide variety of applications. The most practical way to illustrate the technique that we could think of was this egg timer.

TIMING, for a comedian, is an important 'tool of trade', it has been said. So it is with electronics. Delay timers and period timers are used throughout a wide variety of applications in electronics. Delay timers activate something *after* a predetermined period while period timers operate something *for* a predetermined period.

Hobbyists cannot live by electronics alone . . . to twist an old saying, and if one can combine the hobby with food preparation, one survives to build another project!

Hence, the egg timer.

Now all one needs is an electronically-controlled beer and wine fermenter and nourishment would be complete.

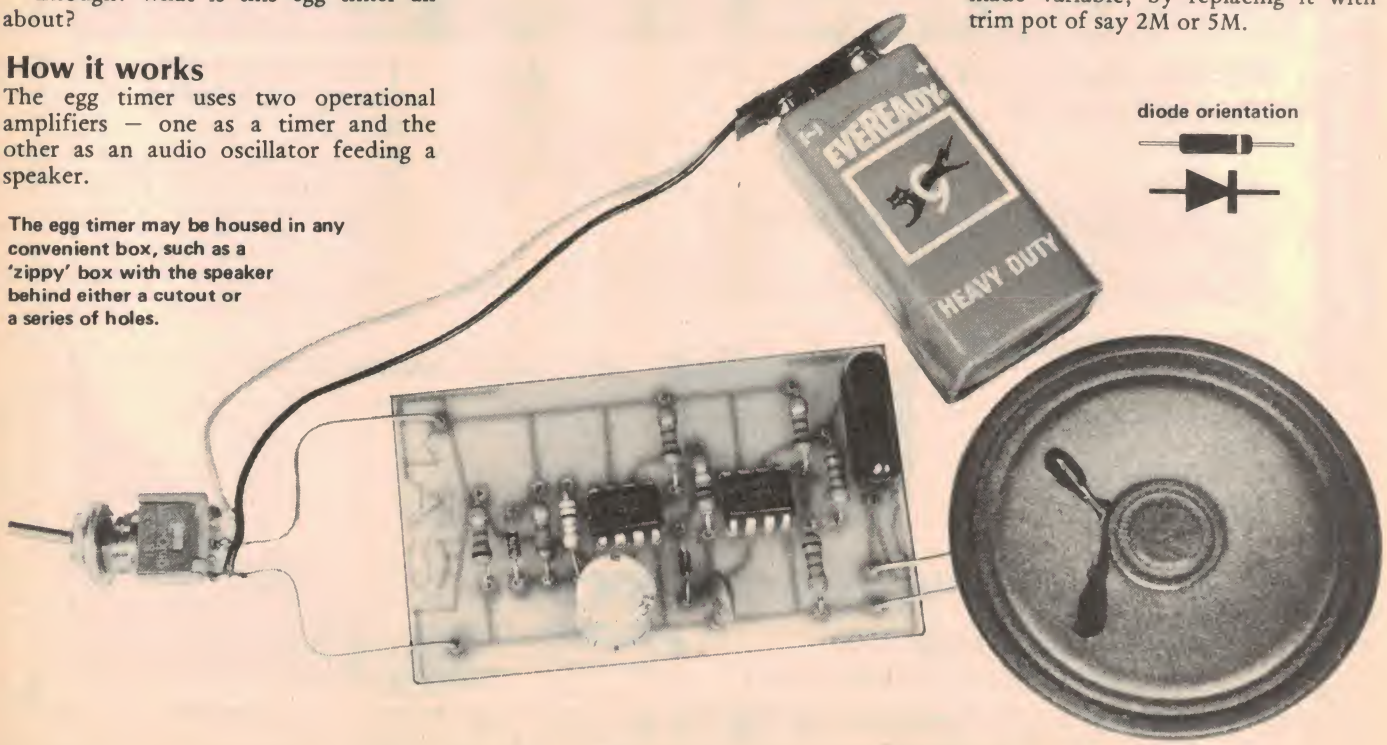
Enough! What is this egg timer all about?

How it works

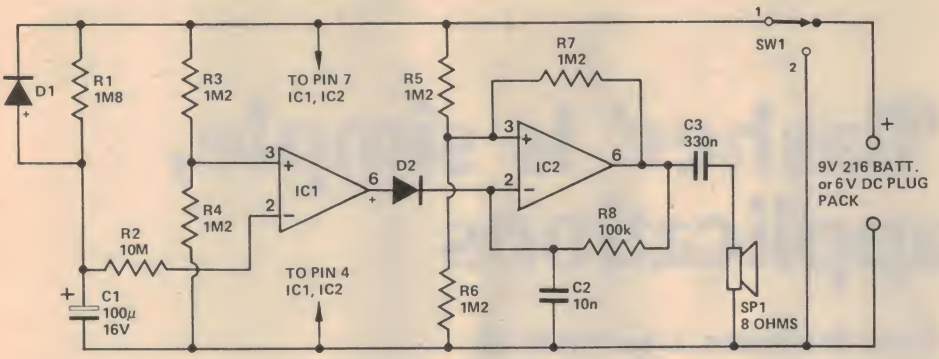
The egg timer uses two operational amplifiers — one as a timer and the other as an audio oscillator feeding a speaker.

IC1 performs the timing function. As there is no negative feedback from the output back to the inverting input (marked '-') the amplifier works at maximum gain. The output will swing hard from one supply rail to the other for very small voltage differences between the inputs. A resistive divider, R3 and R4, holds the non-inverting input (marked '+') at half supply voltage so, when the inverting input is slightly lower than the non-inverting input the output will go high, and when it is higher the output will go low. The op-amp acts as a very sensitive switch controlled by the voltage polarity between the inputs.

The R-C network R1 and C1 forms a charging circuit on the inverting input of the op-amp. When switch SW1 is in the off position the capacitor is shorted out via the diode D1 and the switch. This insures the capacitor is always fully discharged before the circuit is turned on. When SW1 is switched to the on position the timing capacitor, C1, starts to charge through R1. The output of the op-amp remains high (at full supply voltage) until the voltage on C1, and therefore the inverting input, rises to just over the voltage on the non-inverting input. At this point the op-amp output goes low. The period of the delay time is set by the values of R1 and C1. If an adjustable time is required R1 could be made variable, by replacing it with a trim pot of say 2M or 5M.



The egg timer may be housed in any convenient box, such as a 'zippy' box with the speaker behind either a cutout or a series of holes.



the plate or hard as nails) the timing resistor R1 can be substituted with a 2M or 5M trim pot, or could even be a potentiometer mounted on the front of the box. As the circuit draws no current when it is not being used it should give very good battery life, unless you forget to switch it off (but boy, is that noise annoying after five minutes!). ●

The second op-amp IC2 is used as a gated audio oscillator. Positive feedback, sometimes called hysteresis, is provided by R7 and negative feedback by the network R8 and C2. The positive input is again held at half the supply by R5 and R6.

When the unit is first switched on the output of IC1 is high, holding the negative input of IC2 high and preventing the circuit from oscillating.

After the timing period the output of IC1 goes low, forcing the negative input of IC2 low through D2. The output of IC2 goes high because its non-inverting input is at a higher voltage than the inverting input. The positive feedback through R7 increases the voltage on the non-inverting input, increasing the differential voltage between the inputs. Capacitor C2 starts to charge through R8 and the voltage on the inverting input rises. Diode D2 becomes reverse biased and the voltage on the inverting input continues to rise until it is just above the voltage on the non-inverting input. The op-amp output then goes low.

Now the positive feedback reduces the voltage on the inverting input and C2 starts to discharge through R8 until the voltage on the inverting input is just lower than the non-inverting output. The op-amp output switches over again — it's oscillating.

The oscillation continues at a frequency which is determined by the values of R8 and C2 and the amount the positive feedback changes the voltage on the non-inverting input, this also depending on the value of R7. The voltage on the inverting input swings between the upper and lower voltage limits on the non-inverting input.

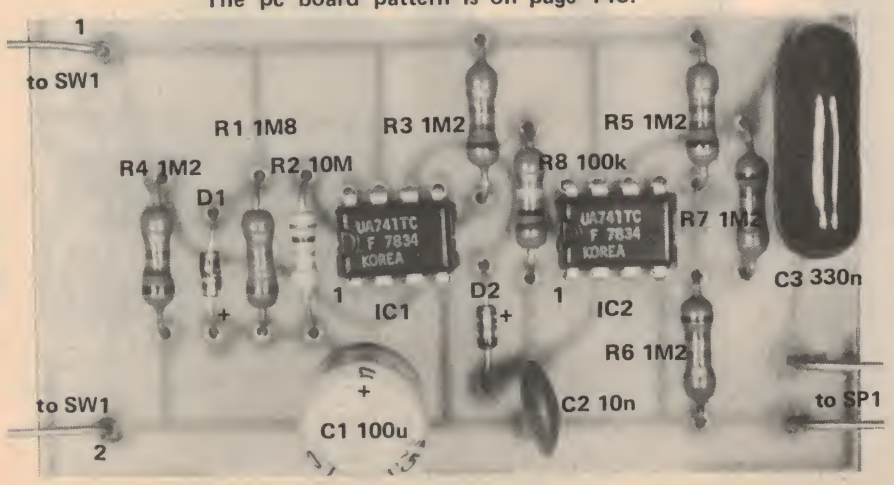
The output from the oscillator is a square wave which is fed to the speaker.

Construction

This project could be constructed on matrix board or printed circuit board as we have shown here. Take care with the orientation of the diodes and ICs. Other than that, construction is quite straightforward. Mind you connect the battery leads correctly or the project could be a disaster microseconds after you first switch it on.

The egg timer can be mounted in any convenient box but be sure to label the switch "OFF-TIME" as it could get confusing. If you want a variable time (if you like your eggs running all over

The pc board pattern is on page 145.



PARTS LIST - ETI 263

Resistors all ½W, 5%
R1 . . . . . 1M8
R2 . . . . . 10M
R3–R7. . . . 1M2
R8 . . . . . 100k

Capacitors
C1. . . . . 100µ 16V electro
C2. . . . . 10n greencap
C3. . . . . 330n greencap

Semiconductors
D1, D2 . . . . 1N914

IC1, IC2 . . . . 741 op amp

Miscellaneous
SW1. . . . . SPDT min toggle switch
SP1 . . . . . 8 ohm speaker

ETI 263 pc board, 9 V battery and battery clip or Plug Pack.

This lamp 'flasher' is simple, has many applications

This circuit, simple though it is, illustrates a number of common circuit 'building blocks'.

CIRCUITS which flash a light, or turn something on and off at a fairly slow rate, are widely used in electronics. Many car alarms, for example, have a light installed on the dash of the car that flashes about once per second to indicate that the alarm is 'armed'. A flashing light is used as a warning indicator in many situations. This circuit illustrates the electronic principles involved, as well as having practical uses – but we'll leave those to your inventive imaginations!

How it works

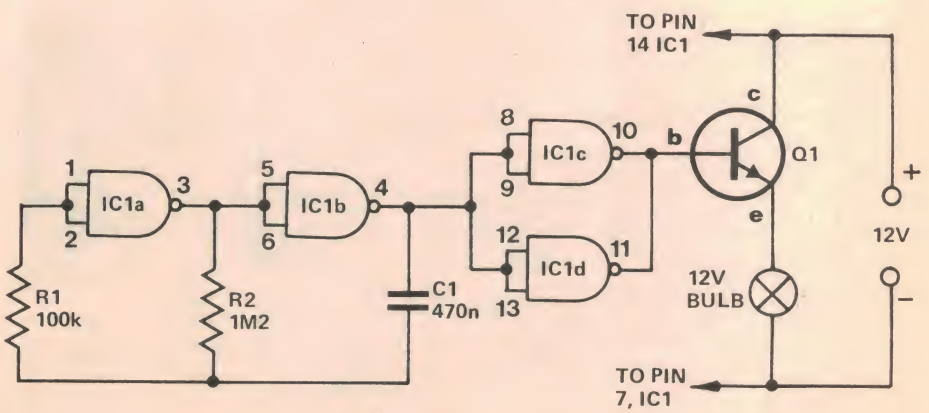
The heart of this circuit is a CMOS digital IC containing four NAND gates. Two are used to form a low-frequency oscillator, ICIa and ICIb. A NAND gate is a functional circuit block which has two 'inputs' and an 'output'. When both inputs are 'high', the output will be 'low'. For any other combination of input conditions, the output will be high. The 'high' and 'low' terms here refer to the voltage on the gate's terminals. Above a certain limit, the terminal (input or output) will be 'high', below that limit, it is said to be 'low'. A 'high' level will be close to the supply voltage; a 'low' level, close to zero volts.

If we connect the two inputs of a NAND gate together then it will act as an 'inverter'. Thus, if the input to this inverter is high, the output will be low; if the input is low, the output will be high.

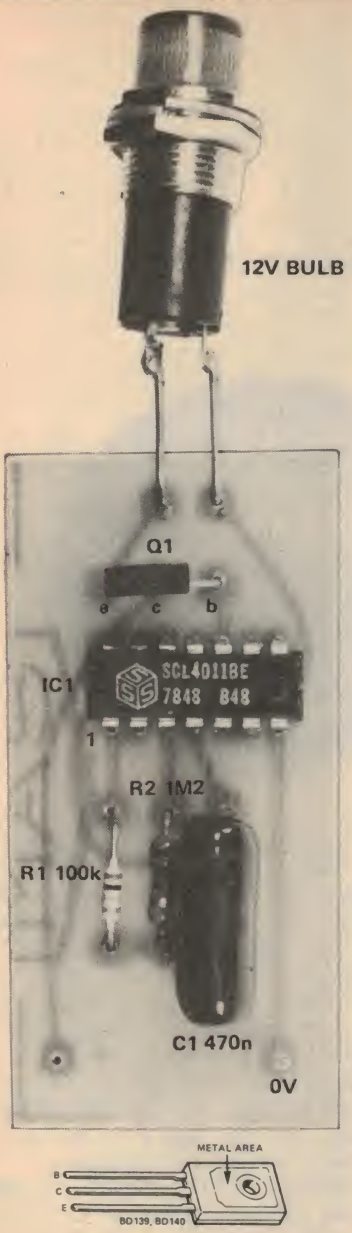
The oscillator in this circuit consists of two NAND gates from the package connected as inverters with the output of one (ICIa) connected to the input of the other (ICIb).

When the circuit is first turned on, the input of ICIa will be low and its output (pin 3) high. The output of ICIb will therefore be low. The capacitor, C1, will start to charge via R2 as one end of R2 is connected to pin 3 of IC1a which is high (in this case, at 12 V). The voltage on C1 is fed back to the input of IC1a via R1. Eventually, the voltage on C1 will reach a point where the input of IC1a will be high and the output (pin 3) will go low. This will produce a high on the output of IC1b and C1 will then discharge via R1 as the input of IC1a and the output of IC1b are both high. C1 will not charge via R2 as the value of R1 is very much less and the discharge current will be much greater than the possible charge current. The current through R1 will hold the output of IC1a high until the capacitor is discharged. At this point there is nothing to hold the input of IC1a high and it will go low, the output (pin 3) will go high and the output of IC1b (pin 4) will go low, and – you guessed it, we're back where we started!

The whole process will repeat itself, the frequency of oscillation depending on the values of R2 and C1. In this case, the frequency is about one cycle per second, or 1 Hz. This oscillator is one form of "multivibrator". Another is illustrated in our Fog Horn project.



The pc board pattern is on page 145.



To turn a lamp on and off requires a little more circuitry. We couldn't connect the lamp at the output of IC1b as it would rapidly discharge C1 at the wrong time! To switch the 150-200 mA required by the lamp, we use a transistor to amplify a small current supplied to its base, the lamp being connected between the emitter and the negative side of the supply. This sort of circuit is called an "emitter follower". This is a *current* amplifier.

The output of IC1b is still unable to drive the base of Q1 directly as, again, when the output of IC1b (pin 4) would be supplying current to the base of Q1, the capacitor, C1, would discharge rapidly, upsetting the frequency of oscillation. Thus, we have used the other two NAND gates to form a "buffer". IC1a and IC1d are connected as inverters with their inputs and outputs connected in parallel. As the inputs require a miniscule current to operate the gates they can be connected directly to the output of IC1b. The outputs of IC1c and IC1d will supply enough current to the base of Q1 to turn it on, the emitter current lighting the lamp.

Each time the output of IC1 goes low, the outputs of IC1c and IC1d (pins 10 and 11) go high, Q1 turns on and the lamp lights. When the output of IC1b goes high, pins 10 and 11 of IC1 go low, Q1 turns off and the lamp goes out.

Construction

There is nothing critical about the construction. You can use the printed circuit board we have designed for this project or build it up on matrix board — tag strips are a bit impractical for mounting IC1!

Take care with the connections to IC1 and Q1 — see that you have them correctly oriented. Q1 has a metal plate set into one side of it. This is to enable heat to flow from the transistor chip inside the package to a heatsink to which the device may be bolted. In this application a heatsink is unnecessary. Note that the collector is connected to the metal plate on the package, as well as having its own connection pin.

The power supply must be connected correctly — reverse connection will almost certainly damage IC1 and Q1.

This circuit may be modified to operate a relay which controls something else — to pulse a horn or a siren, for example. The lamp may be replaced by a 12 V relay; common types have a coil resistance of between 180 and 300 ohms or so and may be substituted directly. The relay contacts should be rated to switch the voltage used on the device being controlled as well as handle the current drawn by it. Your supplier should be able to assist.●

PARTS LIST - ETI 260

Resistors all ½W, 5%
R1 . . . . . 100k
R2 . . . . . 1M2

Capacitors
C1. . . . . 470n greencap

Semiconductors
IC1 4011
Q1 . . . . . BD139

Miscellaneous
Printed circuit board ETI 260; 12 V bezel lamp with holder.

An electronic fog horn

Electronic devices that simulate everyday sounds are always interesting. This fog horn is also instructive.

IF YOU LIVE ON the shores of a busy harbour, you have probably been woken up occasionally in the early morning by the sound of a ship's fog horn. Before the advent of radar, fog horns were the only means ships' captains had of avoiding collisions. The distance and direction of the low-pitched sound gave an indication of another craft's position. Despite radar, many boats and ships (Sydney ferries in particular!) still have fog horns in active service.

This project won't wake the household (or the neighbours!) but it certainly makes a realistic sound.

How it works

The fog horn consists of an oscillator, which generates the basic sound, and a speaker driver. The oscillator we used is known as a "multivibrator". This type of circuit is widely used – in one form or another – in electronics, it is one of the 'building blocks' used in many complex circuits. For example; you will find multivibrators in 'clocking' circuits for timing applications, in function generators and many digital circuits.

The multivibrator here consists of Q1, Q2, C1, C2 and R1 to R4. To understand how it oscillates, we must first make an assumption: let us assume Q2 turns on when the push-button, PB1, is operated. One or other of the transistors, Q1 or Q2, will turn on first as no two devices are *exactly* the same.

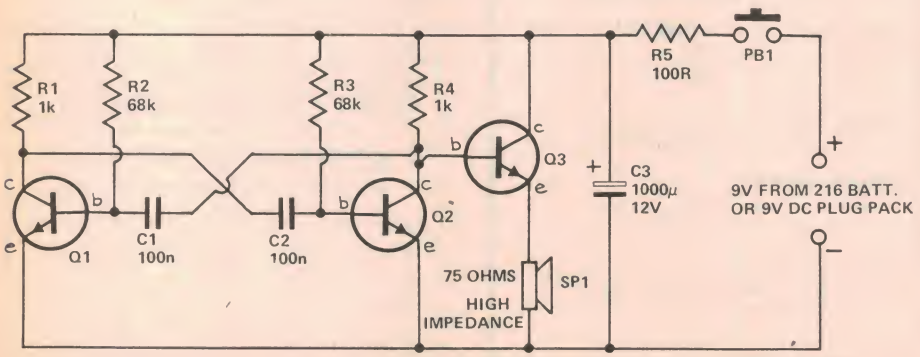
Now, when PB1 is pushed, Q2 conducts and Q1 will be 'cut off' (not conducting). The collector voltage on Q1 will be at the supply voltage (about +9 V) and the base of Q1 almost at zero volts as C1 will not be charged and the collector voltage on Q2 will be close to zero (as Q2 is on). C2 will charge via R1 and the base of Q2, keeping Q2 on while it charges. C1 will begin to charge via R2, and when the base voltage on Q1 has risen sufficiently, Q1 will commence to conduct. The collector voltage on Q1 will rapidly fall. This will cause the charge on C2 to reverse-bias the base of Q2, immediately turning it off. Thus, the collector voltage on Q2 will jump to the supply voltage and C1 will begin to charge via R4 and the base of Q1, holding it on while C1 charges.

However, C2 will begin to charge – in the opposite direction to which it was first charged – and the negative voltage on the base of Q2 (from C2) will decrease, pass through zero and rise in a positive direction. When it has risen sufficiently for the base of Q2 to conduct once more, Q2 will turn on.

And the whole business begins again. The charge on C1 will reverse bias Q1 which turns right off, C2 will charge via R1, driving Q2 further on . . . until C1 charges (via R4) sufficiently to turn Q1 on again, etc.

Thus, the collector voltages on Q1 and Q2 will alternately rise, stay up for a period, fall and stay down for a period, then rise again – a square wave.

That's your basic, or common-garden-variety, multivibrator. The frequency of oscillation is dependent on the values (and thus the time-constant) of R1, C2 and R2, C1. An output can be taken from the collector of either Q1 or Q2. The signal on one



collector will be the opposite phase to that on the other collector (while one collector is up, or 'high', the other collector is down, or 'low').

The output from the oscillator will not be able to drive the speaker directly. This is because the oscillator has a high impedance output and cannot supply enough current to drive the relatively low impedance of the speaker. To increase the available current, and lower the output impedance, we use an emitter follower, where the input is fed to the base of a transistor, Q3, and the output is taken from the emitter. The voltage output from the emitter follower is very close to the input voltage, but the current is amplified sufficiently to drive the speaker.

But what about R5 and C3. Well, these help to give the oscillator its characteristic sound. The multivibrator generates the basic low pitch of the fog horn. But, if you listen carefully to a real fog horn, you will notice that the pitch and volume vary slightly as it sounds. Now, the frequency of a multivibrator depends on the supply voltage to a large extent. The lower the supply, the lower the frequency, and vice-versa. Also, the output, and thus the volume, is lower at lower supply voltages — vice-versa.

When PB1 is pushed, C3 will take a short while to charge and therefore the voltage supply to the oscillator (and speaker driver) will take a short while to rise. Thus, the sound from the speaker will have the characteristic rising pitch and volume of the first part of a fog horn's blast. When PB1 is released, C3 will take a short while to discharge and the sound level and pitch will die away.

In this way, the circuit simulates the characteristic sound of a ship's fog horn.

Construction

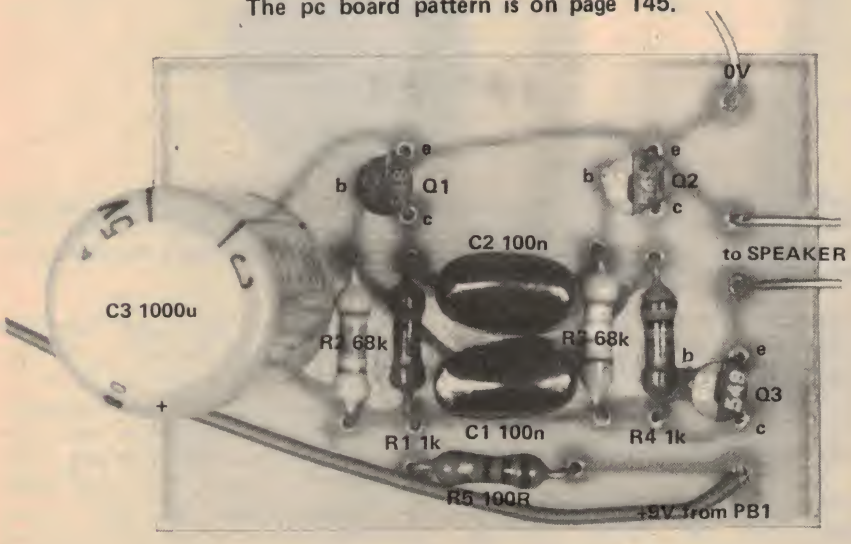
This circuit is simple enough to be constructed on matrix board or tag strips. However, we have used a printed circuit board. If you are not yet confident of getting all the connections right, we suggest you construct this project as we have. Printed circuit boards should be available from quite a number of suppliers. See our "Shoparound" and "Kits for Projects" pages in this issue.

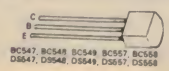
No matter what method of construction you elect to use, as always, take care with the orientation of the transistors and the polarity of the battery connections. The speaker we used is rather an unusual item. Small speakers commonly have an impedance of either eight or 16 ohms. The one used here has an impedance of 75 ohms. Refer to "Shoparound" on page 83 for sources of supply of this component.

You can modify the sound of the fog horn if it is not quite to your satisfaction — normal component variations will produce differing results. You can vary the basic sound produced by the multivibrator by varying C1 and C2. Changing these by one standard value higher or lower will produce quite a gross variation in pitch. Smaller variations can be obtained by having several capacitors in parallel. Use a large value — close to that specified — and connect a smaller value capacitor in parallel, for each of C1 and C2.

The rising and falling pitch and volume is controlled by R5 and C3. The value of R5 can only be practically varied a small amount. You get a much more satisfactory result by varying the value of C3 or varying its discharge time. You can decrease the 'die away' period by putting a low-value resistor in parallel with C3, increasing the discharge current. Start experimenting with something like 680 ohms. ●

The pc board pattern is on page 145.





PARTS LIST - ETI 261

Resistors — all ½ W, 5%
- R1 . . . . . 1k
- R2, R3 . . . . . 68k
- R4 . . . . . 1k
- R5 . . . . . 100R

Capacitors
- C1, C2 . . . . . 100n Greencap
- C3. . . . . 1000µ, 12V electro

Semiconductors
- Q1–Q3. . . . . BC548, BC108, DS548 or similar

Miscellaneous
- SP. . . . . high impedance speaker, greater than 40 ohms
- PB1. . . . . push-to-make momentary push button

No.216, 9 V battery or suitable battery eliminator (Ferguson PPA 9DC or similar); ETI 261 pc board.

A simple intercom

The perenially popular intercom — this circuit illustrates how to wring the maximum performance from the minimum number of components.

AN INTERCOM is an eminently *practical* device. Communication between rooms in a house is immensely aided by an intercom. The same goes for house and garage – or any other outbuilding.

The drawback with many intercoms is that that can be *too* effective. They shout at you. Whilst one can turn down the volume by one means or another, it's rather like using a sledge hammer to crack an acorn – as the saying goes. This intercom is simple, inexpensive and is ideally suited to quiet situations where volume is not all-important.

A small loudspeaker serves as both microphone and speaker in this intercom. Housing the project we have left up to you. It is quite possible to fit the components in a palm-sized box, such as one of the small 'zippy' boxes available inexpensively from a number of suppliers. The intercom may be powered from a 3 Vdc plugpack if you wish.

How it works

At first glance this circuit looks very simple, but its operation is quite ingenious as it performs different functions for transmit and receive.

To allow us to understand how it works, let's look at the receive mode first. When the pushbutton is not pressed the loudspeaker is connected across the line, in series with the battery. None of the remaining components are used in the receiver as they are isolated from the battery by the pushbutton. The battery voltage is connected across the line in series with the loudspeaker and is fed to the transmitter. Any change in current drawn by the transmitter will cause a movement of the cone of the loudspeaker. If a speech signal is fed down the line it will be heard in the remote speaker.

If you speak into the cone of a loudspeaker, the cone will vibrate in sympathy with the changing air pressure from the sound. The vibration of the cone moves the voice coil of the speaker which cuts the lines of force in the magnetic field of the speaker magnet. When a wire is moved through a magnetic field it generates a current in the wire in sympathy with the movement. The loudspeaker can thus be used as a microphone, the speech signal output being taken from the voice coil as it converts the sound energy impinging on the cone to electrical energy in the voice coil.

In the transmit mode, the battery is isolated from the circuit by the depressed pushbutton and the supply voltage appears across the line from the receive station. The signal from the loudspeaker passes through a capacitor, C2, which blocks the dc from the battery but allows the speech signal to pass to the base of Q3. The transistors Q2 and Q3 form a high gain pair which amplifies the speech signal and drives the output stage, Q1. The output transistor varies the amount of current drawn from the line in sympathy with the speech. Because this current moves

the cone in the receiver loudspeaker, the speech can be heard at the receiver.

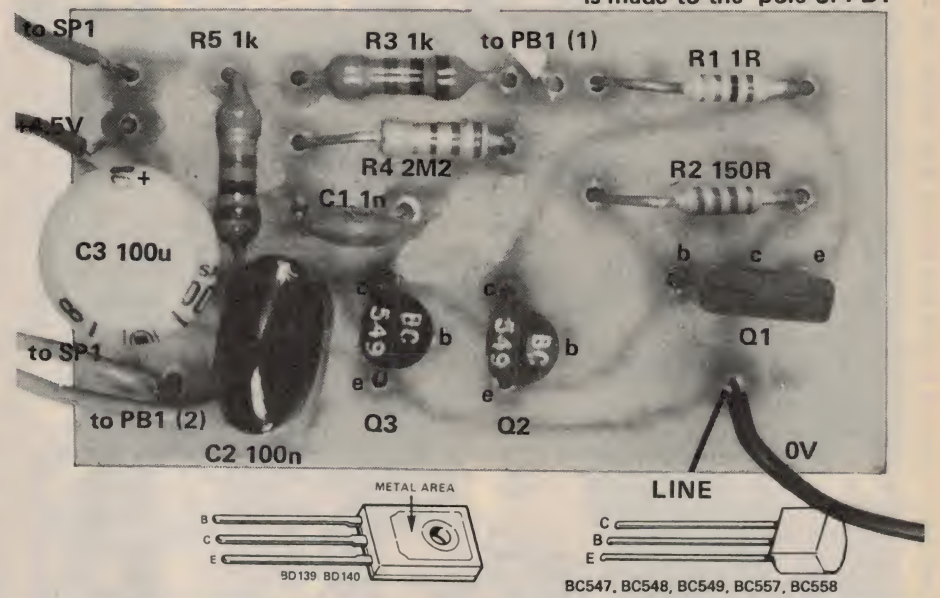
As the frequency spectrum of speech is mainly within the range 200 Hz to 3 kHz, the frequency response of the transmitter has been limited to about 3 kHz by placing a small capacitor across the base-collector junction of Q3. This causes a reduction in gain of that stage at high frequencies by introducing negative feedback which increases with frequency. Resistors R2, R3 and R4 set the bias on the stages and the one ohm resistor, R1, provides some emitter bias on the output stage as well as limiting the maximum output current.

The transmitters have been designed to work with supply voltages as low as 2½ volts. However, a 4½ volt supply allows for quite a high voltage drop in the line so that the intercom may work over quite a long line. We tried it over the length of the office (about 30 m) but some readers will, no doubt, have much greater distances in mind. For really long line lengths, the battery voltage could be increased to say, six volts.

Construction

We constructed one of our units on matrix board and the other on a pc board. Both methods work equally well, though constructing the matrix board version is a little more tedious and requires some care so that incorrect connections are not made. The orientation of the transistors is the only point to watch.

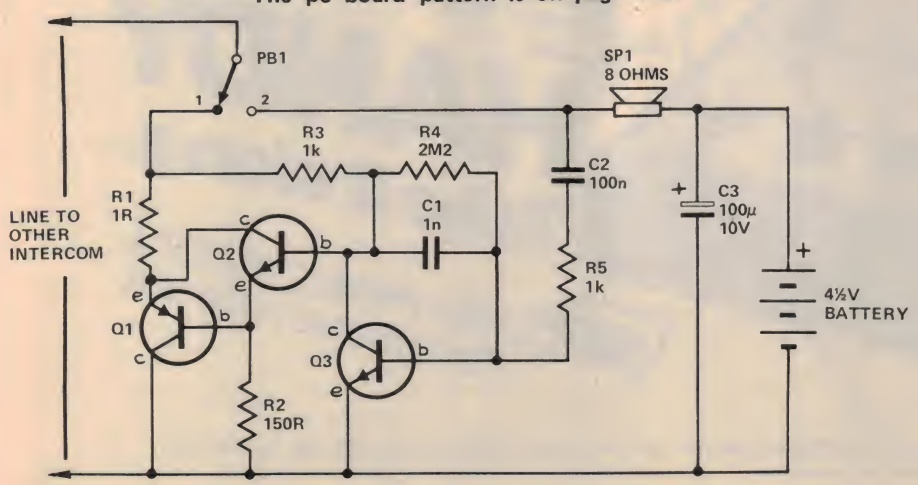
To power the intercom units, a standard 4½V battery may be used at each end. For longer battery life, three D-cells would be better, wired in series. If power is available, a 3 V plug-pack battery eliminator at each end should provide about four to five volts with the unit in operation.



Overlay for the pc board. Take care with the orientation of the capacitor C3 and the transistors.

We assembled one unit on a piece of matrix board, laid out as shown.

The pc board pattern is on page 145.



PARTS LIST - ETI 262

Resistors all ½ W, 5%
- R1 . . . . . 1R
- R2 . . . . . 150R
- R3 . . . . . 1k
- R4 . . . . . 2M2
- R5 . . . . . 1k

Capacitors
- C1. . . . . 1n
- C2. . . . . 100n
- C3. . . . . 100µ 10V electro

Semiconductors
- Q1 . . . . . BD140
- Q2, Q3 . . . . . BC549, BC109, DS549.

Miscellaneous
- PB1. . . . . SPDT push button
- SP1 . . . . . eight ohm speaker
- B1. . . . . 4½ V battery or three 1½ V cells in series (with holders if required), ETI 262 pc board.

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Synergistic, adj. From Greek - synergos - working together.

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S29 E.A. Playmaster 137 3 watt
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TE5 ETI 130. Temperature Meter
TE6 ETI 706. Marker Generator
TE7 ETI 709. R.F. Attenuator
TE8 ETI 122. Logic Tester
TE9 ETI 124. Tone Burst Generator
TE10 ETI 123. C Mos Tester
TE11 ETI 116. Impedance Meter
TE12 ETI 533. Digital Display
TE13 ETI 117. Digital Voltmeter 1975 Display
TE14 ETI 117. Digital Voltmeter 1976 Display
TE15 ETI 704. Cross Hatch Dot Generator
TE16 ETI 120. Logic Probe
TE17 ETI 121. Logic Pulser
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TE34 ETI 487. Real Time Audio Analyser
TE35 ETI 483. Sound Level Meter
TE36 ETI 489. Real Time Audio Analyser
TE37 ETI 717. Cross Hatch Gen.
TE38 E.A. 3 Mhz Frequency Counter
TE40 E.A. Direct Reading Ohm Meter
TE41 E.A. Function Generator
TE42 E.A. Transistor Tester Incl. BIPolar & F.E.T.S.
TE43 ETI 591. Up Down Pre-setable Counter
TE44 ETI 550. Digital Dial (less case) includes ETI 591

WARNING SYSTEMS
WS1 ETI 583. Gas Alarm
WS2 ETI 066. Temperature Alarm
WS3 ETI 528. Home Burglar Alarm
WS4 ETI 702. Radar Intruder Alarm
WS5 ETI 220. Walling Siren
WS6 ETI 219. Hee Haw Siren
WS7 ETI 313. Car Alarm
WS9 ETI 503. Electronic Thief Trap
WS10 ETI 506. Infra Red Intruder Alarm
WS11 ETI 305. Automatic Car Alarm System
WS12 ETI 582. House Alarm
WS13 E.A. Electronic Siren
WS14 E.A. 1976 Car Alarm
WS15 E.A. 10 Ghz Radar Alarm

PHOTOGRAPHIC
PH1 ETI 586. Shutter Speed Timer
PH2 ETI 548. Photographic Strobe (less reflector)
PH3 ETI 514B. Sound Light Flash Trigger
PH4 ETI 532. Photo Timer
PH6 ETI 505. High Powered Strobe (less reflector)
PH7 ETI 513. Tape Slide Synchronizer
PH8 ETI 512. Photographic Process Timer
PH9 ETI 515. Slave Flash
PH10 ETI 540. Universal Timer
PH11 E.A. 1970 Stroboscope Unit (less reflector)
PH12 E.A. Sync-A-Slide
PH13 E.A. Auto Trigger for Time Lapse Movies
PH17 ETI 558. Mast Head Strobe
PH15 ETI 553. Tape Slide Synchronizer
PH17 E.A. Digital Photo Timer
PH17 ETI 594. Development Timer

MODEL TRAIN UNITS
MT1 ETI 541. Model Train Control
MT2 E.A. 1974 Model Train Control
MT3 E.A. 1971 S.C.R. P.U.T. Control Unit
MT4 E.A. Electronic Steam Whistle
MT5 E.A. Electronic Chuffer
MT6 E.A. 1978 Train Control

AUTOMOTIVE UNITS
A1 ETI 317. Rev. Monitor
A2 ETI 081. Tachometer
A3 ETI 316. Transistor Assisted Ignition
A4 ETI 240. High Power Emergency Flasher
A5 ETI 239. Break Down Beacon
A6 ETI 312. Electronic Ignition System
A7 ETI 301. Vari-Wiper
A8 ETI 502. Emergency Flasher
A9 ETI 302. Tacho and Dwell Meter
A10 ETI 303. Brake Light Indicator
A11 ETI 309. Battery Charger
A12 E.A. 1970 C.D.I.
A13 E.A. High Efficiency Flasher
A14 E.A. Dwell Meter
A15 E.A. Variwiper
A16 E.A. Tacho for Tune-ups
A17 E.A. Ignition Analyser & Tacho
A18 E.A. Strobe Adaptor for Above
A19 E.A. 1975 C.D.I.
A20 E.A. Mains P.S. for Car Cass
A21 E A. Automatic H D. Batt. Charger
A22 ETI 318. Digital Car Tacho. (less metalwork)
A23 ETI 319A. Variwiper Mk. 2 (No dynamic braking)
A24 ETI 319B. Variwiper Mk. 2 (For dynamic braking)
A25 ETI 320. Battery Condition Indicator

GUITAR UNITS
G1 ETI 447. Audio Phaser
G2 ETI 413. 2 x 200 watt Bridge Amplifier
G3 ETI 424. Spring Reverb Mixer
G4 ETI 408. Reverberation Unit
G5 ETI 413. 100 watt Guitar Amplifier
G6 ETI 410. A.D.U. for your Guitar
G7 E.A. PM 125 50 watt Guitar Amplifier
G8 E.A. PM 134 21 watt Guitar Amplifier
G9 E.A. PM 138 20 watt Guitar Amplifier
G10 E.A. Waa Waa Unit
G11 E.A. Fuzz Box
G12 E.A. Sustain Unit
G13 E.A. PM 135 12 watt Guitar Amplifier

PRE-AMPLIFIERS AND MIXER
P1 ETI 445. Stereo Pre-amplifier
P2 ETI 449. Balance Mic Pre-amplifier
P5 ETI 414. Master Mixer 8 channel
P6 ETI 419. Mixer Pre-amplifier — 4 ch; Mixer Pre-amplifier — 2 ch
P7 ETI 401. F.E.T. 4 Input Mixer
P8 E.A. Playmaster 127 Control Unit
P9 E.A. Simple Mixer for Pick up & Mic
P10 E.A. Playmaster 145 Mixer
P11 ETI 446. Audio Limiter
P13 ETI 477 Series 4000 Moving Coil Cartridge Pre Amplifier
P14 ETI 471 Pre Amplifier

TUNERS
T1 ETI 062. A.M. Tuner
T2 ETI 740. F.M. Tuner
T4 E.A. Playmaster 146 AM-FM Tuner

VOLTAGE/CURRENT CONTROLS
V ETI 481. 12 volt to — 40V D.C. 100 watt Inverter
V2 ETI 525. Drill Speed Controller
V3 E.A. S.C.R. Speed Controller
V4 E.A. Stage (etc.) Auto Dimmer 2 K.W.
V5 E.A. Stage (etc.) Auto Dimmer 4 K.W. & 6 K.W. add on for above
V6 E.A. 1976 Speed Control
V7 ETI 592. Light Show Controller (3 ch.) (1000 w/ch)
V8 E.A. Inverter 12V D/C Input 230V 50hz 300VA output

POWER SUPPLIES
PS1 ETI 132. Experimenters Power Supply
PS2 ETI 581. Dual Power Supply (High Powered Version)
PS3 ETI 712. CB Power Supply
PS4 ETI 131. Power Supply
PS5 ETI 119. 5 volt Switching Regulator Supply
PS6 ETI 105. Laboratory Power Supply
PS7 ETI 111. I/C Power Supply
PS8 E.A. D.C. Voltage Reference
PS9 E.A. 1976 Regulated Power Supply
PS10 E.A. Dual 20-2 0-30V at 2A or 0-60V at 2A or Dual Pos and Neg 30V at 2A
PS11 E.A. C.B. Power Supply
PS12 ETI 142. Power Supply 0-30V 0-15A (fully protected)

RECEIVERS/TRANSMITTERS
R1 ETI 711. Remote Control T/X Switch
R2 ETI 711R. Remote Control Receiver
R3 ETI 711D. Remote Control Decoder
R4 ETI 711B. Single Control
R5 ETI 711C. Double Control
R6 ETI 711P. Power Supply
R7 ETI 707A. 144 MhZ Converter
R8 ETI 707B. 52 MhZ Converter
R9 ETI 708. Active Antenna
R10 ETI 710. R.F. Power Amplifier
R11 ETI 780. Novice Transmitter
R12 ETI 703. Antenna Matching Unit
R14 E.A. 240 Communications Receiver
R15 E.A. 110 Communications Receiver
R16 E.A. 160 Communications Receiver
R17 E.A. 130 Communications Receiver
R18 E.A. All Wave I/C2
R19 E.A. Deltahet S/S Mk. 2 Comm R/X
R20 E.A. Fremodyne 4 Complete Kit
R21 E.A. Fremodyne 4 RF Section
R22 E.A. PM 138 Tuner Receiver
R23 E.A. Mos Fet 52 Mhz Converter
R24 E.A. 2-6 Mhz Converter
R25 E.A. 6-19 Mhz Converter
R28 E.A. V.H.F. Power Match
R29 E.A. Short Wave Converter for 27 Mhz
R30 E.A. Simple S.W.R. Meter
R31 E.A. 27 Mhz Pre-Amp
R32 E.A. 10-30 Mhz Pre-Amp
R33 ETI. Aircraft Band Converter

COMPUTER AND DIGITAL UNITS
C1 ETI 633. Video Synch Board
C2 ETI 632M. Part 1 Memory Board V.D.U.
C3 ETI 632P. Part 1 Power Supply V.D.U..
C4 ETI 632A. Part 2 Control Logic V.D.U.
C5 ETI 632B. Part 2 Control Logic V.D.U.
C6 ETI 632C. Part 2 Character Generator V.D.U.
C7 ETI 632. Mother Board including P/S
C8 ETI 632. U.A.R.T. Board
C9 ETI 631-2. Keyboard Encoder
C10 ETI 631. A. Sch. Keyboard Encoder (less keyboard)
C11 ETI 630. Hex Display
C12 E.A. Educ-8 Computer
C13 E.A. Cassette-Tape Interface
C14 ETI 638. Eprom Programmer
C15 ETI 637. Cuts Cassette Interface

MISCELLANEOUS KITS
M1 ETI 604. Accentuated Beat Metronome
M2 ETI 546. C.S.R. Monitor (less probes)
M3 ETI 549. Induction Balance Metal Locator less Search Head
M4 ETI 547. Telephone Bell Extender
M5 ETI 602. Mini Organ (less case)
M6 ETI 544. Heart Rate Monitor
M7 ETI 044. Two Tone Doorbell
M8 ETI 043. Heads and Tails
M9 ETI 068. L.E.D. Dice Circuit
M10 ETI 539. Touch Switch
M11 ETI 529. Electronic Poker Machine
M12 ETI 236. Code Practice Oscillator
M14 ETI 701. Masthead Amplifier
M15 E.A. I/C Volume Compressor
M17 E.A. Electronic Anemometer
M18 E.A. 240 volt Lamp Flasher
M19 E.A. A/C Line Filter
M20 E.A. Bongo Drums
M21 E.A. Keyless Organ
M22 E.A. Auto Drums
M23 E.A. Electronic Roulette Wheel
M25 E.A. Digital Metronome
M26 E.A. Voice Operated Relay
M27 E.A. Gas Detector Car; Boat
M28 E.A. Led Chaser
M29 E.A. Sound Effects Generator
M30 ETI 551. Light Chaser 3 channel 1000 watt/ ch.
M31 E.A. Electronic Machine
M32 E.A. Remote TV Headphone
M34 ETI 650 STAC Timer
M35 ETI 557. Reaction Timer
M36 ETI 249. Combination Lock (less lock)
M37 E.A. Combination Lock (including lock)
M38 E.T.I. 576 Electromyogram

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Universal software-controlled EPROM programmer

Wayne Wilson

MOST MICROCOMPUTER systems require some program to be permanently resident in memory: in general purpose systems, this will be a monitor program or bootstrap loader, while in dedicated systems such as traffic light controllers, it will be the actual operating program. The program will therefore have to be stored in read only memory (ROM), a pre-programmed type of storage which, once written, cannot be erased or modified by the system itself, and which is not affected when power supplies are removed.

There are three types of ROM – mask-programmed ROM, which is programmed during manufacture, and is only economical in large quantities; PROM (programmable ROM), which can be programmed by the user; and EPROM (erasable PROM), which can be erased under ultravoilet light for subsequent re-use.

EPROMs are available in several types and memory capacities; the major types are shown in Table 1. Each has a slightly different method of programming. The basic method is to supply the chip with the appropriate address and data signals, and then apply a pulse to the programming pin. On the 2708, for example, the address and data is presented and then a programming pulse of 26 V is applied for somewhere between 0.1 and 1 ms. Then the next address and data are set up, and that location programmed, and so on until all locations in the EPROM have been addressed. This sequence is then repeated between 100 and 1000 times, until the EPROM has been programmed.

The 2716, on the other hand, is much simpler to program. The programming supply does not have to be pulsed; instead the programming pin is pulsed at TTL levels with the programming supply continuously applied. In addition, each location only has to be programmed once, and it can be programmed individually, unlike the 2708, in which the whole EPROM has to be programmed up to 1000 times.

For the complete programming requirements for the different EPROMs, consult the manufacturer's data sheets.

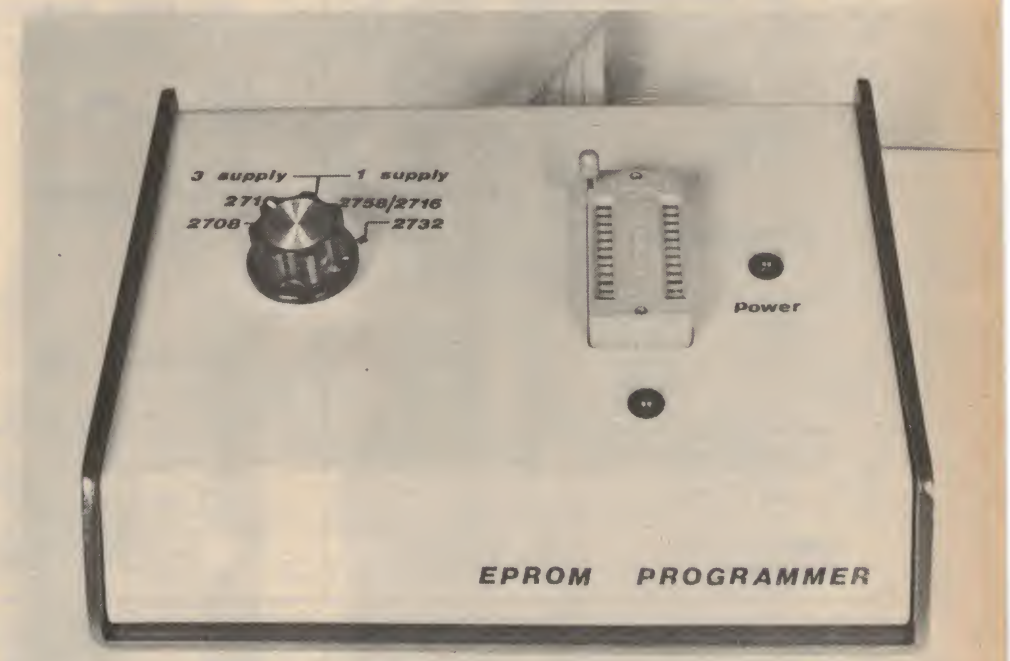


TABLE 1 – EPROM types

Type	Capacity	Supplies	Programming problems
1702	256 x 8	±5, +12	
2708	1024 x 8	±5, 12	Programming supply must be switched, needs each location programmed up to 1000 times
2758	1024 x 8	+5	Programming pulse is TTL level, any location can be programmed
2716	2048 x 8	+5 (Intel)	can be programmed
		±5, +12 (TI)	can be programmed
2732	4096 x 8	+5	can be programmed

It can be seen that an EPROM programmer which can program all the available types of EPROM has to be a fairly versatile piece of equipment.

Circuit features

The EPROM programmer described here was designed by Wayne Wilson of Acoustic Electronic Developments to meet the demand for an inexpensive device which could handle the different types of chip. It is designed to use the intelligence of a host computer to provide the sophisticated control and timing required.

The programmer is designed to run on a +8 V, ±18 V power supply, i.e. the standard S-100 bus supply voltages. The interface to the computer requires one 8-bit output port and two 8-bit bidirectional ports. These must be bidirectional to enable the computer to read the contents of the EPROM, in order to check that it has been programmed correctly, or that it is fully erased before programming.

The easiest way to interface the programmer is through an Intel 8255 ▶

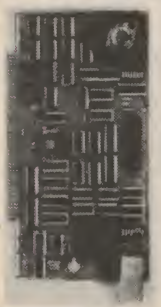
CAPTAIN ZILOG! —THE FIREWORKS HAVE JUST BEGUN!!

Presenting the Z8000 Microprocessor for the 1980's. The Z8000 has regular architecture to simplify design, 418 OP codes for incredible programming power, can perform 32 Bit operations and even address 8M bytes directly. Want to know more? Z8000 data Pack 1 includes complete technical data on Z8000 and its growing family of peripherals, development systems and software.

Z8000 TECHNICAL PROGRAM

Z8000 Data Pack	$ 3.50
Z80 CPU Technical Manual	$10.00
Z80 CPU Programming Manual	$10.00
ZILOG Data Book	$ 5.00

DGZ–80 HOME COMPUTER ON S100 BUS. AFFORDABLE – EXPANDABLE – POWERFUL



Build your own Z80 based computer using the DGZ 80 (ETI 680) as described in ETI November, 1979, designed by David Griffiths this is probably the most powerful Z80 project described in the world to date. Features include on board PIO (dual 8 bit INPUT OUTPUT), CTC (Programming Counter Timer) power on jump, software write protect, cassette interface, option 2K monitor, on board RAM for stack, scratchpad etc. sockets for all IC's, top quality solder masked, plated through PCB and comprehensive owners manual.

DGZ80 (Kit) . . $199.25 ($175.00 Sales Tax exempt)
(Assembled) . . . $240.00 ($215.00 Sales Tax exempt)

Optional–but strongly recommended . . .

DGOS Monitor ROM 2716 . . . . . $ 48.00

DG640–VDU

Designed by David Griffiths this is an ideal support for the DGZ 80. Just add a keyboard with power supply to the DGZ 80 and DG 640 and you have a 4K Z80 system.

Described in ETI March, 1978 the DG 640 features 16 lines of 64 characters, upper, lower case with graphics, crystal locked self-contained TV scan circuitry, top quality plated through PCB with solder mask, sockets for all IC's and comprehensive owners manual.

DG 640 (Kit) . . $139.50 ($125.70 Sales Tax exempt)
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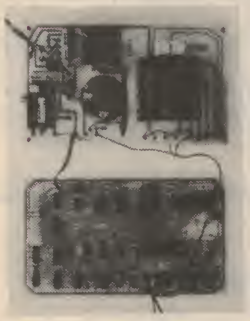
DREAM 6802–HAVE FUN WHILE LEARNING ABOUT MICRO COMPUTERS



Learn as you build this fascinating microprocessor project designed by Michael Bauer and published in Electronics Australia, May, 1979.

We have designed the PCB to use the latest 6802 chip which has a self contained clock driver (eliminates 6875 problem) and is fully 6800 compatible. A separate PCB is also supplied containing an 18 key keyboard, power supply and modulator.

All components are supplied including top quality fibreglass PCB's, keyboard, modulator, chipos in 2708, 6802 and full data sheets. Also included is a detailed operators manual with construction notes and exciting programs for you to run.

Dream 6802 (Kit) $149.50

COMPONENT SPECIALS

Z80	CPU	$16.50
Z80	PIO	$ 9.75
Z80	CTC	$ 9.75
6802	CPU	$15.50
6821	PIO	$ 5.75
6810	RAM	$ 3.75
2708	EPROMS	$14.50
2114	4K RAMS	$ 6.75
555	TIMERS–4 for	$ 1.00

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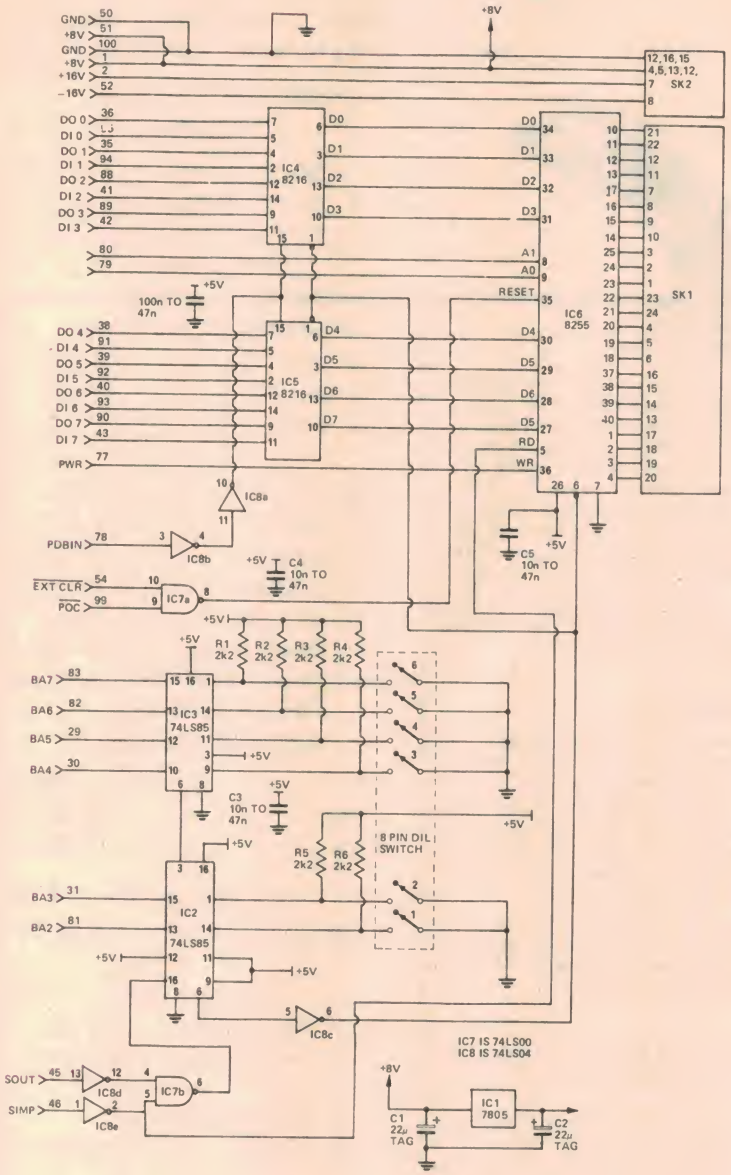


Figure 1. **Suggested address decoding circuitry for use with the ETI-643 EPROM Programmer for systems not provided with an 8255 general purpose I/O chip. SK1 connects to SK1 on the ETI-643.**

HOW IT WORKS – ETI 643

HARDWARE

The EPROM Programmer circuitry consists primarily of two types of circuits – switches and power regulators. There are four switches, to satisfy the programming requirements of the different EPROM types.

Q1, Q2 and two gates of IC1 form a 0V to +12 V switch. When the OE line from the interface is at a TTL high, the output (CS/WE) is pulled down almost to 0 V. Conversely, when the input is low, the output is pulled up to almost 12 V by Q1. R5 provides current limiting and C19 controls risetime, which is critical when programming some EPROMs.

Q3, D1 and associated components form a +5 V to +12 V switch. A TTL high input gives a +5 V output, while with the input TTL low, Q3 turns on and pulls the output up to +12 V. C3 controls the risetime and overshoot.

Q4, D2 and associated components switch from +5 V to +25 V, in a manner similar to that for Q3 etc. Again, C5 controls risetime and overshoot.

Finally, Q5, Q6 and other miscellaneous components switch from 0 V to +25 V. When the input is high, the output is near 0 V, but if the input is TTL low, the output is near 25 V. R14 is a current limiter, and C7 controls the risetime.

There are four power supply regulators: IC4, IC5, and IC6 are straightforward monolithic voltage regulator ICs, to provide the +5 V, +12 V and –5 V supplies respectively. In order to obtain the 25.4 V supply from the S-100 bus, a voltage doubler circuit is required. IC2 is a 555 set up as an astable multivibrator; its output is fed to a voltage doubler consisting of C9, C10, D3 and D4. The output of this circuit is fed to a voltage regulator, IC3, the common pin of which is fixed above ground by potential divider R16, R17.

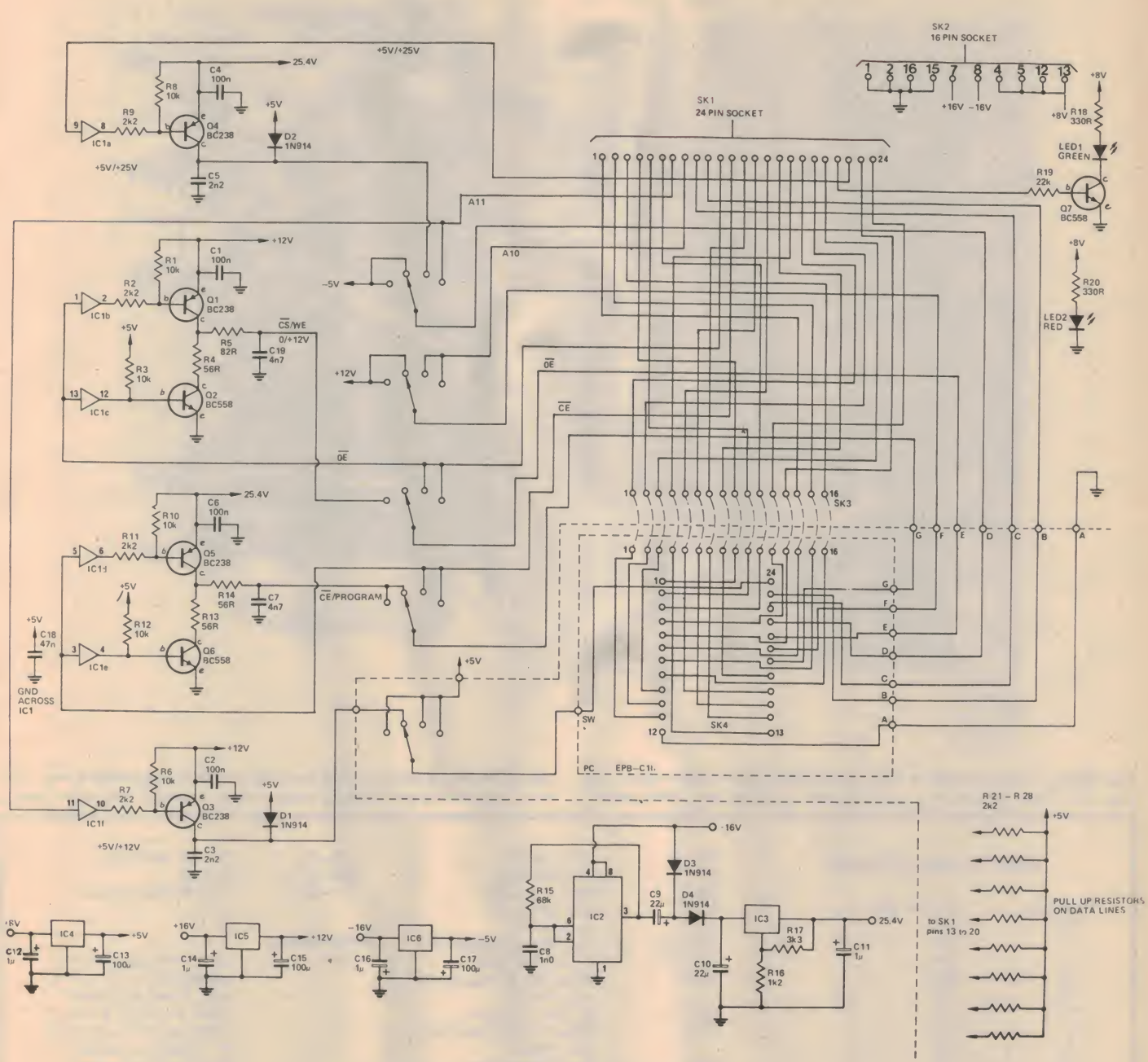
Q7 is switched by a bit from the computer I/O port to turn on LED1. LED2, across the +8 V supply indicates that power is applied and the programmer plugged in.

programmable input/output chip. This general purpose I/O chip is often found on parallel I/O cards for the S-100 bus, such as those supplied by Acoustic Electronic Developments and SM Electronics, amongst others. Alternatively, one can wire-wrap some address decoding circuitry and an 8255 on a prototyping card, and a suitable circuit is shown in Figure 1.

Users of other microcomputers or bus structures should be able to adapt this circuit to suit their own requirements. Alternatively, some single-board microcomputers may well have enough I/O pins on board to interface directly to the programmer. Boards which have two Motorola 6820 PIAs or MOS Technology 6520s, for example, could drive the EPROM programmer, though of course the software would have to be re-written.

Construction

The EPROM Programmer is built on two printed circuit boards, one of them double-sided and through-hole plated. This is not in any way due to the circuit complexity – it is, in fact, a remarkably simple circuit. The problem lies in the complexity of wiring associated with SW1 which switches the address, chip enable, supply and programming signals around to suit the different pin-outs of the various EPROMs. SW1 is a



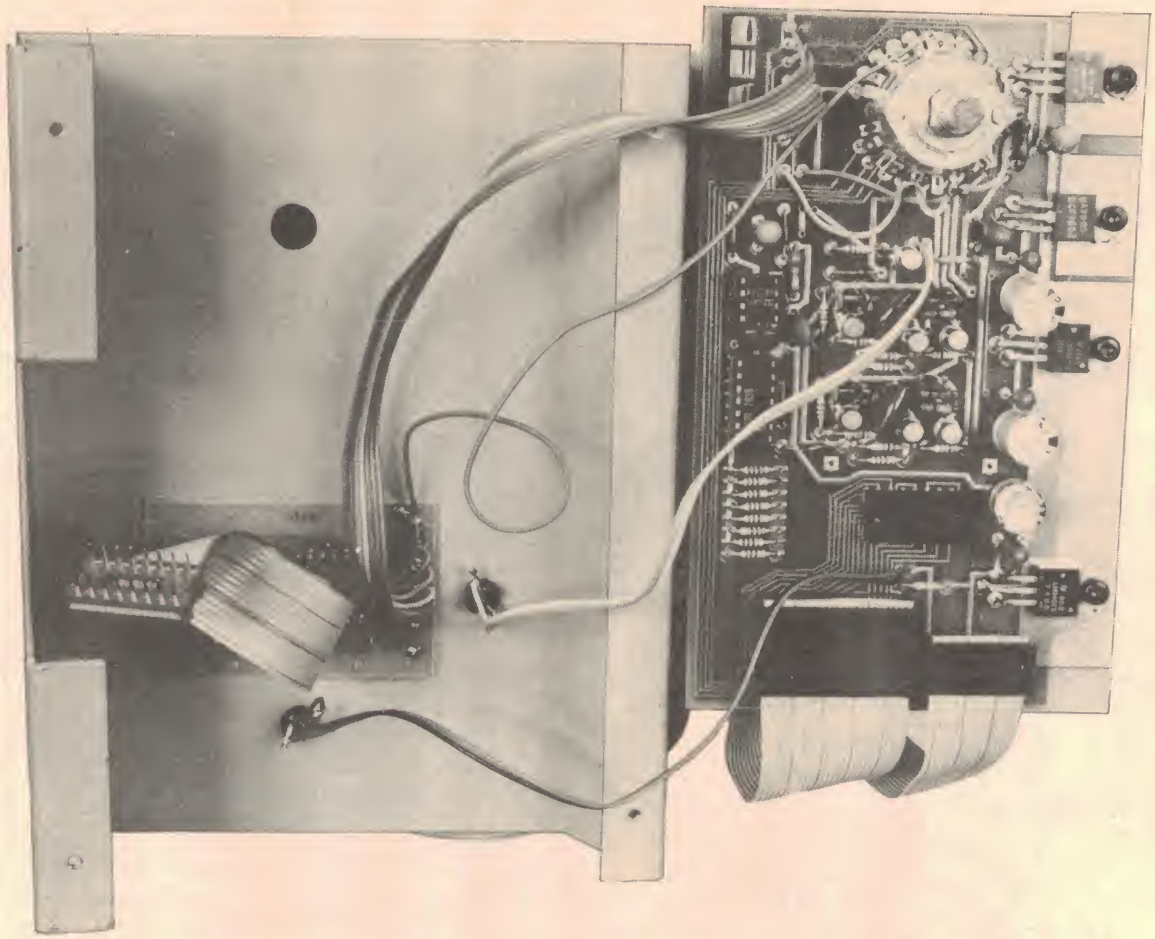
Complete circuit of the ETI-643 EPROM Programmer

5-pole, 4-position selector switch which mounts directly onto the main pcb, with only four pins to be hand wired to the two pcbs. The two printed circuit boards are linked by a short length of 16-way ribbon cable.

None of the components are particularly special or difficult to get hold of, with the exception of SW1, which is a Lorlin switch mechanism with 1-off 4-pole, 4-position BBM wafer and 1-off 2-pole, 6-position BBM wafer set for 4-position action. In any case, Acoustic Electronic Developments have assured us they will have all components in stock, including pcbs, case, Textool zero-insertion-force socket and the switch, and kits will be available from AED and other suppliers.

The construction sequence is absolutely standard, with sockets being inserted and soldered first, followed by resistors, capacitors, diodes, transistors, ICs, LEDs and then the switch. The small amount of point-to-point wiring can then be done.

Initial checkout is simple: the power supplies can be applied one at a time and the outputs of the regulator ICs checked with a DVM or multimeter. If these check out OK, then TTL level signals can be applied to the switches and their outputs checked. If all of these are OK, then your programmer should run first time without any problems. If there are difficulties then the switch circuitry and the interface cabling should be checked for dry joints, faulty connections, etc. ▶



The project was mounted in a suitable-sized custom-made aluminium case. The main pc board is quite securely held by the Lorlin switch which mounts directly on the front panel. The low-insertion-force socket is soldered to the small pc board which is glued to the front panel.

PARTS LIST - ETI 643

Resistors all ¼W, 5%

R1 . . . . . 10k
R2 . . . . . 2k2
R3 . . . . . 10k
R4 . . . . . 56R
R5 . . . . . 82R
R6 . . . . . 10k
R7 . . . . . 2k2
R8 . . . . . 10k
R9 . . . . . 2k2
R10. . . . . 10k
R11. . . . . 2k2
R12. . . . . 10k
R13, R14 . . . 56R
R15. . . . . 68k
R16. . . . . 1k2
R17. . . . . 3k3
R18. . . . . 330R
R19. . . . . 22k
R20. . . . . 330R
R21–R28 . . . 2k2

Capacitors

C1. . . . . 100n greencap
C2. . . . . 100n ceramic
C3. . . . . 2n2 greencap
C4. . . . . 100n ceramic
C5. . . . . 2n2 greencap
C6. . . . . 100n greencap
C7. . . . . 4n7 greencap
C8. . . . . 1n ceramic
C9, C10 . . . . 22µ 25V tag tantalum
C11, C12. . . . 1µ 35V tantalum
C13. . . . . 100µ 25V pc mounting electrolytic
C14. . . . . 1µ 35V tantalum
C15. . . . . 100µ 25V pc mounting electrolytic
C16. . . . . 1µ 35V tantalum
C17. . . . . 100µ 25V pc mounting electrolytic
C18. . . . . 47n greencap
C19. . . . . 4n7 greencap

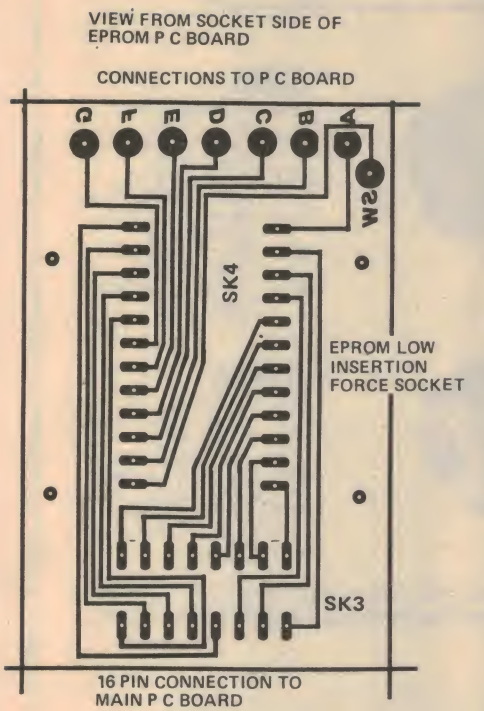
Semiconductors

IC1 . . . . . SN7407
IC2 . . . . . NE555
IC3 . . . . . 7815 15V regulator
IC4 . . . . . 7805 5V regulator
IC5 . . . . . 7812 12V regulator
IC6 . . . . . 7905 -5V regulator
LED1. . . . . green LED
LED2. . . . . red LED
Q1 . . . . . BC178 or BC238
Q2 . . . . . BC548
Q3–Q5. . . . . BC178 or BC238
Q6, Q7 . . . . . BC548
D1–D4. . . . . 1N914 silicon signal diode

Miscellaneous

SW1. . . . . Lorlin RB type switch mechanism with 1 off 4 pole, 4 position, BBM wafer and 1 off 2 pole, 6 position, BBM wafer, set for 4 position action, fitted with pcb clips.
SK1. . . . . 24 pin IC socket to accept DIP header
SK2, SK3 . . . 16 pin IC socket to accept DIP header
SK4. . . . . 14 pin IC socket
SK5. . . . . 8 pin IC socket
SK6. . . . . Textool 24 pin zero insertion force IC socket
pcbs. . . . . ETI 643A and ETI 643B

Two lengths of 16-way ribbon cable with DIP headers (15 cm & 2m) one length of 24-way ribbon cable with DIP headers (2 m) case, knob, feet, nuts, bolts, screws and assorted hardware.



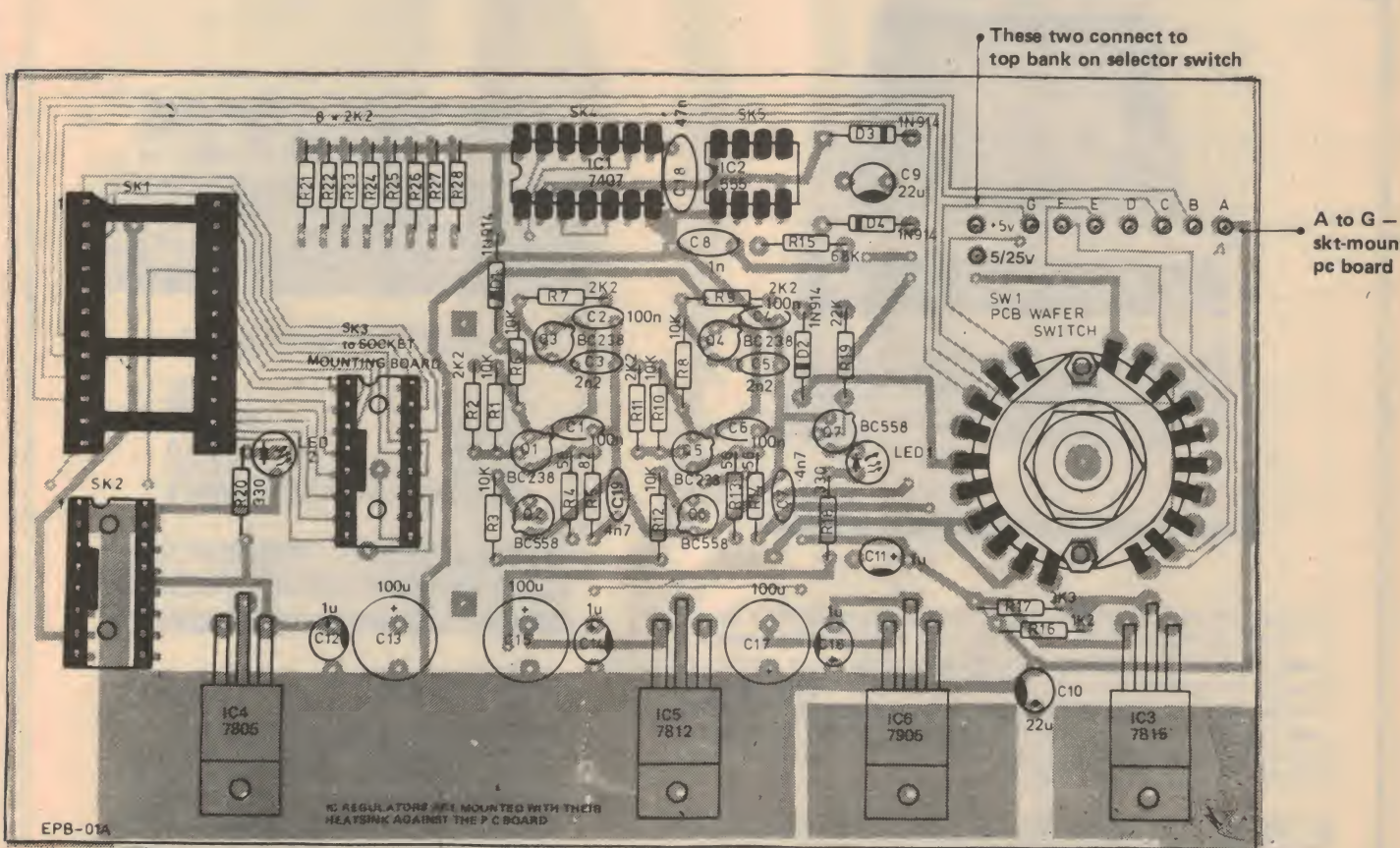
For space reasons, we are unable to present software this month. A complete listing to suit 2708s will appear in the January issue . . . fairies at the bottom of the page printer permitting !

Using the programmer

The programmer is quite easy to use. The EPROM to be programmed, read or compared is inserted into the programmer, and then the control program is run. The first thing the program does is to output a sign-on message with a menu of possible activities and EPROM types. The user then responds to this by typing in a letter followed by a number; for example, to program a 2708, the user would type in B1, and the program will then continue by instructing the user to put switch SW1 in the correct position. All operation is fully automatic and interactive, so the programmer can be used by an inexperienced user.

References

Intel Data Catalog, Intel Corporation, Santa Clara, 1978. National Semiconductor Memory Data Book, National Semiconductor Corporation, Santa Clara, 1977. Also data sheets from: Texas Instruments, Mostek, Fairchild, Motorola. ●



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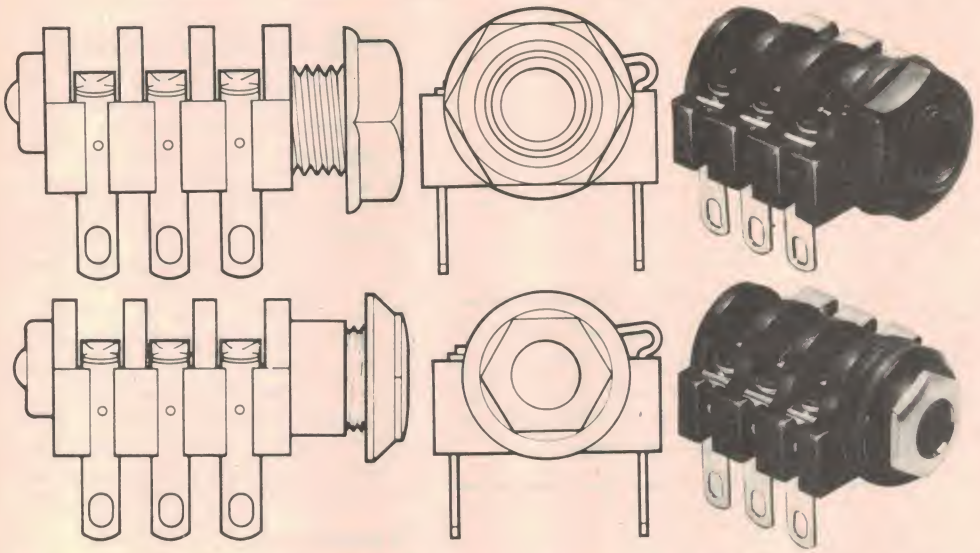

MONO

M100	Plastic fixing nut single : single
M101	Plastic fixing nut single : break
M102	Plastic fixing nut break : break
M120	Chrome fixing bush single : single
M121	Chrome fixing bush single : break
M123	Chrome fixing bush break : break

STEREO

M200	Plastic fixing nut single : single : single
M203	Plastic fixing nut break : break : break
M220	Chrome fixing bush single : single : single
M223	Chrome fixing bush break : break : break

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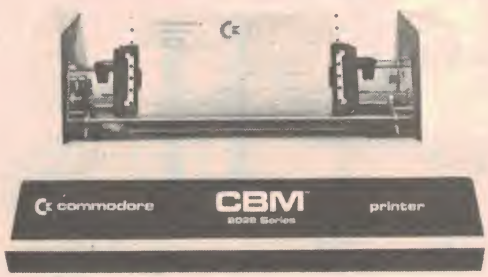

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MPSA93 55
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PN3566 18
PN3567 18
PN3568 18
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7432 30
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7440 30
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74173 . . . . 2.60
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74LS12 30
74LS14 80
74LS15 75
74LS16 60
74LS20 30
74LS21 30
74LS27 30
74LS28 35
74LS30 30
74LS32 30
74LS37 40
74LS38 40
74LS40 30
74LS42 45
74LS73 60
74LS74 40
74LS75 50
74LS78 65
74LS85 . . . . 1.40
74LS86 60
74LS90 60
74LS92 . . . . 1.00
74LS93 85
74LS95 . . . . 1.00
74LS107 75
74LS109 50
74LS113 50
74LS114 55
74LS125 70
74LS133 30
74LS138 . . . . 1.10
74LS151 . . . . 1.00
74LS157 75
74LS160 70
74LS163 80
74LS164 . . . . 1.40
74LS165 . . . . 1.40
74LS169 . . . . 1.90
74LS174 65
74LS175 90
74LS190 . . . . 1.60
74LS191 . . . . 1.30
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74LS193 . . . . 1.00
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74LS366 80
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4049 70
4050 75
4051 . . . . 1.20
4052 . . . . 1.20
4053 . . . . 1.20
4060 . . . . 1.50
4066 90
4068 35
4069 30
4070 30
4071 30
4072 30
4076 . . . . 1.75
4077 30
4078 30
4081 30
4082 30
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1N3493R 1.70
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1N4004 10
1N4007 20
1N4148 06
1N5401 40
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1N5408 80
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78L18 40
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7915 . . . . . 1.60
7918 . . . . . 1.60
7924 . . . . . 1.60
79HG 10.80
79L03 95
79L05 95
79L12 95
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79L18 95
79L24 95
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1W(3V3-33V) 30
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C106D 75
C106E 70
C122D 1.30

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Q1015L5 . . . . . 2.80

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ST4 80

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YELLOW (Std) 30
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SEL103S M/R. 30
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0.33uf 35V 20
0.47uf 35V 20
0.68uf 35V 20
1uf 35V 20
1.5uf 35V 20
2.2uf 35V 20
3.3uf 35V 20
4.7uf 16V 20
4.7uf 35V 30
6.8uf 35V 30
10uf 25V. 25
10uf 35V. 30
15uf 35V. 55
22uf 16V. 30
22uf 35V. 74
33uf 10V. 30
47uf 6.3V 40
47uf 16V. 55

MIN. CERAMIC
1pf-0.03 06
0.047 08
0.1uf 12
0.22uf 20
0.47uf 25

POLYESTER
100V
.001-.027. 10
.033-.056. 12
.068-.1 16
.12-.22 30

250V
0.27uf 30
0.33uf 34
0.39uf 48
0.47uf 50
.56,.68,.82 60
1,1.2,1.5 . . . . . 1.00
1.8uf 1.20
2.2uf 1.40
3.3uf 2.10
4.7uf 3.50

TRIM. CAPACITORS
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2pf-22pf 40
5pf-65pf 30
5.5pf-40pf 40

ELECTROLYTIC. PCB.
6.3V 470uf. 20
1000uf 30
10V 4.7,100uf 10
16V 10uf 08
22,33,47uf. . . . 10
100uf. 15
220,330uf 20
470uf. 25
640uf. 45
1000uf 40
2500uf 65
25V 2.2,3.3uf. 10
4.7,10uf 10
25,33uf. 12
47uf 13
100uf. 15
220uf. 20
330uf. 25
470uf. 35
1000uf 50
2200uf 90
35V 2.2,3.3uf. 10
10uf 15
100uf. 20
220uf. 30
1000uf 70
2000uf 90
2200uf 1.10
50V .47 1 2.2 08
3.3 4.7 10 15
22 33 47 20
100uf. 20
220uf. 50
470uf. 60
63V .47 1 2.2 10
3.3 4.7uf. 10
10 25uf. 15
47uf 20
100uf. 25
220uf. 40
330uf. 45
470uf. 80

ELECTROLYTIC RT. (DOUBLE ENDED)
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330uf. 40
25V 100uf. 25
330uf. 45
2500uf 1.00
50V 2500uf 2.15
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47uf 30
100uf. 40
220uf. 65
470uf. 75
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E12 Series 07
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0.4W 2% 1Ohm-1M
E12 Series 10

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100,250,500,1K,2K,5K,
10K,25K,50K,100K,
250K,500K,1M, all . . 20

Bi-Polar Electro. (all 50V)
1uf, 2.2uf 25
3.3uf, 4.7uf 30
6.8uf 30
10uf, 22uf 40
33uf 50
47uf 69
100uf. 80

Min. "Cermet" Trimpots
Vert. & Horizontal.
all 52

Polystyrene 125V
10,15,22,33,47,68,100,
150,220,330,390,470,
680pf. 45
1000,1500,2200,3300,
4700,6800,10000pf . 55

Computer Grade Electrolytic
2900uf 40V 6.75
6800uf 16V 6.48
10000uf 16V 9.00
10000uf 25V 9.72
10000uf 40V . . . 13.50
15000uf 40V . . . 12.06
22000uf 25V . . . 14.22
22000uf 40V . . . 23.40
27000uf 35V . . . 24.48
33000uf 16V . . . 13.50
68000uf 16V . . . 22.32
1000000 10V . . . 22.32

POLYPROPOLENE (HIGH CURRENT)
0.047uf 400V 40
0.056uf 400V 40
0.47uf 200V. 90

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15Kohm(Dist). 75
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20,24 . . . . . 3.60
22. . . . . 1.80
26. . . . . 3.70
28. . . . . 4.50
31. . . . . 5.60
32. . . . . 5.50
33,34 . . . . . 6.10
36,37 . . . . . 3.30
38,39,40 . . . . . 3.30

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2M 1.45

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HY120 60W 95.00
HY200 100W . . 133.00
HY400 240W . . 180.00
OM350 . . . . . 7.90
LM379S 6.90

IC SOCKETS
8 pin 20
14 pin 25
16 pin 28
18 pin 65

Lab Notes

An occasional series in which we discuss interesting circuit techniques, circuits we have tried in our own laboratory but not developed as a project, practical notes on projects, measurement techniques for hobbyists etc.

The Wein Bridge oscillator

Probably the most popular type of low frequency sine wave oscillator as it is superior in virtually all respects to phase-shift types. Unfortunately it does not seem to be all that well understood. This article sheds some light on this most useful circuit.

Staff

MOST STUDENTS of electronics – that includes hobbyists, you learn from your hobby don't you? – would be familiar with the "Wheatstone Bridge"; that often-handy technique for measuring unknown values of resistance. The Wein Bridge is an outgrowth of the Wheatstone Bridge. The basic circuit is shown in Figure 1.

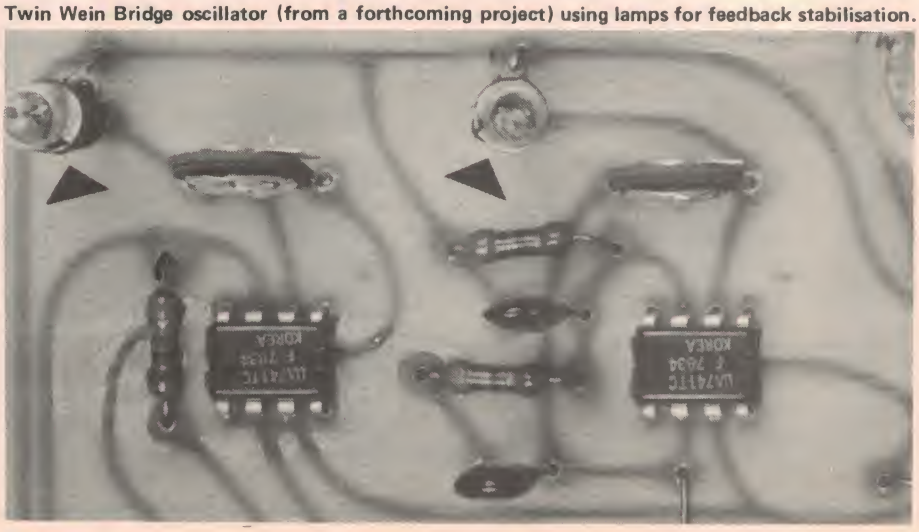
This circuit has some unique properties. The networks R1-C1 and R2-C2 form a potential divider between points A and B. Both networks have an impedance which decreases with frequency. At one frequency, and one frequency *only* (depending on the values of R1-C1 and R2-C2), the bridge will be balanced. That is, if a sinewave voltage is applied between A and B, no voltage will appear across C and D. Another interesting, and useful property of this bridge is that, at the balance frequency, the phase of the voltage across C and B will be *exactly* the same as that across A and B. The same will be true for harmonics of the balance frequency, *but*, the impedances of R1-C1 and R2-C2 will not be the same as at the balance frequency and the bridge will be unbalanced.

Well, how are these properties of the Wein Bridge used in an oscillator? The basic circuit of a Wein Bridge oscillator is shown in Figure 2. The component numbering of the Rs and Cs is the same as in Figure 1. We are assuming that the amplifier has good common-mode rejection, an infinite input impedance and zero output impedance. Fortunately, an op-amp is a reasonable approximation to this and the circuit as shown will work well with a common-or-garden 741 at frequencies up to 10 kHz.

The Wein Bridge components are connected such that positive and negative feedback is applied around the op-amp. This should be readily apparent from the way Figure 2 is drawn. The negative feedback is derived from the resistive potential divider R3 and R4. Positive feedback is provided by the potential divider R1-C1 and R2-C2. The amount of positive feedback through R1-C1 will *increase* with frequency as this network has a *decreasing* impedance as frequency increases. The parallel RC network formed by R2-C2 also has *decreasing* impedance with *increasing* frequency, tending to shunt the amount of applied positive feedback (via R1-C1) to ground. At the balance frequency, the applied positive feedback will be a maximum, falling at frequencies above and below the balance frequency. However, if the bridge is balanced, the positive feedback and the negative feedback will be equal ... and the circuit will not oscillate. *But*, if the amount of negative feedback provided by R3-R4 is chosen to be fractionally less than the positive feedback at the balance frequency, the circuit will oscillate. Since negative feedback predominates *at all other frequencies*, and the bridge remains unbalanced, harmonics of the balance (or resonant) frequency are suppressed and the waveform produced will be a sine wave of great purity.

In practise it is necessary to include some means of sensing the amount of negative feedback so that the amplifier gain can be held at the precise amount necessary to ensure oscillation. If the amount of negative feedback is too little, the waveform will be distorted. If too much, oscillation will not occur. Secondly, if the gain varies (for whatever reason) the feedback needs to be stabilised to prevent distortion and level variations.

Twin Wein Bridge oscillator (from a forthcoming project) using lamps for feedback stabilisation.



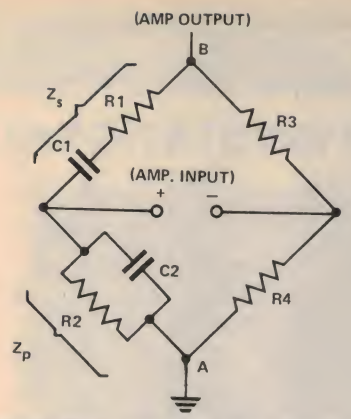


Figure 1. **Basic circuit of the Wein Bridge.**

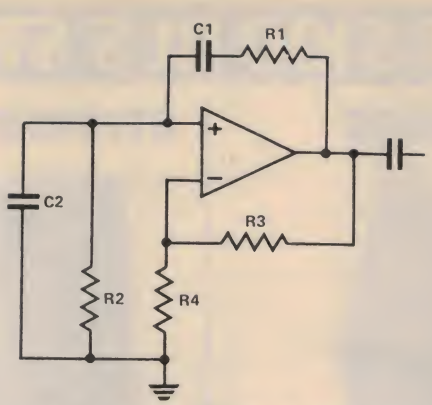


Figure 2. **Basic Wein Bridge oscillator circuit.**

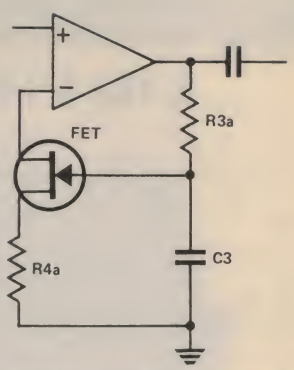
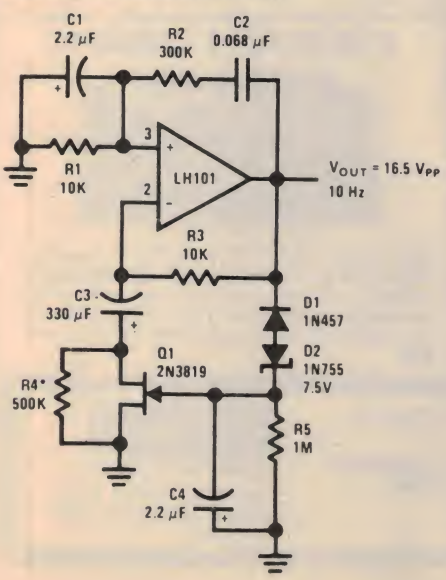


Figure 3. **Feedback stabilisation using a FET.**

The simplest way of doing this is to incorporate a thermistor or tungsten filament lamp in the negative feedback potential divider. If the latter is used for this purpose – and common light bulbs used for bezel lamps have tungsten filaments – it would replace R4 so that gain increases of the amplifier stage cause increased current in the lamp. This, in turn, would cause the temperature of the filament to rise, increasing its resistance, thus increasing the amount of negative feedback. The use of these temperature variable devices sets a limit on the lowest frequency at which the circuit can be used. When the period of oscillation is comparable to the thermal time constant of the particular light bulb or thermistor, the change in resistance over each cycle will bring about gain variations which result in distortion of the output waveform. Also, these devices have a "settling time" that prohibits the frequency from being changed quickly in a variable oscillator using this circuit.

Figure 4. **Example of a practical Wein Bridge oscillator with a FET in the feedback (courtesy National Semiconductors).**



The solution to these problems entails using a FET as part of the feedback element. The FET becomes part of R4 – as shown in Figure 3 – driven by an RC network between the op-amp output and the gate. In this way, the 'averaging time' of the circuit can be tailored to suit the job required. An example of a practical circuit is given in Figure 4.

A lot of the advantages, and the unique properties of the circuit, become apparent from a look at the mathematics involved; it's quite straightforward really.

The impedance of C1, at a certain frequency 'f', is given by:

$$Z_{C1} = \frac{1}{j\omega C}$$

Where: Z_{C1} = impedance of C1

$= 2\pi f$

$j = \sqrt{-1}$

So the total impedance, Z_s, of the series network R1-C1 is given by:

$$Z_s = R1 + \frac{1}{j\omega C}$$

Since the impedance of capacitor C2 is also given by:

$$Z_{C1} = \frac{1}{j\omega C}$$

Where: Z_{C2} = impedance of C2

$\omega = 2\pi f$

$j = \sqrt{-1}$

and C2 is in parallel with R2, the total impedance of the parallel network R2-C2 (Z_p) is given by:

$$\frac{1}{Z_p} = \frac{1}{R_2} + \frac{1}{\frac{1}{j\omega C}}$$

therefore: $\frac{1}{Z_p} = \frac{1}{R_2} + j\omega C$

Oscillation will occur when:

$$\frac{R3}{R4} = \frac{Z_s}{Z_p}$$

since it is this condition which will result in unity gain.

If we let R3 = 2 x R4, and substitute this in the equations for Z_s and Z_p, this equation becomes:

$$\frac{2R4}{\frac{1}{R2} + j\omega C} = R4\left(R1 + \frac{1}{j\omega C}\right)$$

and this simplifies to: $\omega^2 = \frac{1}{R1\ R2\ C1\ C2}$

since $\omega = 2\pi f$,

then $2\pi f = \frac{1}{\sqrt{R1\ R2\ C1\ C2}}$

and $f = \frac{1}{2\pi\sqrt{R1\ R2\ C1\ C2}}$

The major advantage of the Wein Bridge oscillator is its inherent stability and predictable frequency output. In other low frequency oscillators employing RC networks in the feedback, the frequency of oscillation is *directly* proportional to the values of the components in the network. In the Wein Bridge, you can see from the last equation that the frequency of oscillation is proportional to the *square root* of the component values in the network. The ease with which amplitude levelling and level stability can be achieved by using simple thermal devices in the negative feedback is another advantage. Thirdly, the low distortion possible with this circuit contributes greatly to its popularity.

On the other hand, to vary the frequency, two components have to be varied simultaneously – either C1/C2 or R1/R2. The fact that one of these is wholly 'above ground' complicates things – but it's not an insoluble problem as there are many Wein Bridge oscillators around! ●

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OUR MAJOR PROJECT this month, the **Universal EPROM Programmer (ETI-643),** falls in the same category as last month's Z80 microprocessor board, the ETI-680. The cost and time involved for us to design such a project is prohibitive. We don't have to explain how useful and convenient EPROMs are, and thus a programmer project that would accept the various popular EPROM chips available is bound to be popular amongst those involved with microcomputing.

Wayne Wilson, of Acoustic Electronic Developments, approached us some months ago about the EPROM programmer he had designed for A.E.D.'s use. We explained the conditions we have set down concerning acceptance of projects like this and he readily agreed. Thus, ready-made pc boards (double-sided on fibre-glass with plated-through holes) are available, trade and retail, through A.E.D. Contact:

Acoustic Electronic Developments
123 Military Rd
Guildford NSW 2161

In addition, A.E.D. will have supplies of the C&K Lorlin switch, zero-insertion-force socket, metalwork, etc, plus documentation. A number of other kit suppliers have expressed interest in the project so kits may be subsequently available from further sources in the future.

For those patient, skilful enthusiasts who have the capability and knowledge to make up their own double-sided pc boards (with plated-through holes ? — good luck to you) a good quality print of the artwork will be available through the magazine. Send a stamped, self-addressed envelope to:

ETI-643 EPROM artwork
Electronics Today International
15 Boundary St
Rushcutters Bay NSW 2011

The only restriction to this offer is that you must be a private constructor making a project for your own use.

The C&K Lorlin Switch and the zero-insertion-force socket are available separately through these suppliers:

Applied Technology, Hornsby NSW
Radio Despatch Service, Broadway NSW
Ellistronics, Melbourne Vic.

If digital is not your main desire, then perhaps experimenting with **solar cells** takes your fancy. The solar cells we used for our experimental **sun intensity meter** and the **solar-powered one-transistor reflex receiver (ETI-270)** type C202, are made by Sensor Technology and imported by Amtex Electronics. They are quarter 'pieces' of a type C200 circular-shaped solar cell. Four connected in series will produce about 1.6 V and a maximum current of 200 mA. They are available in sets of four direct from the importers at a cost of $11 plus $1 post and packing.

Write to: Amtex Electronics
P.O. Box 285 Chatswood NSW 2067.

The following suppliers indicate they have stocks of these solar cells:

All Electronic Components, Melbourne
Ellistronics, Melbourne Vic
Applied Technology, Hornsby NSW
Electronic Agencies, Concord NSW
Radio Despatch, Broadway NSW

In addition, square-shaped solar cells of a different manufacture and lower current capability are available from David Reid Electronics and Dick Smith Electronics (catalogue No: Z-4820).

All the other components used this month are commonly available from most suppliers. The high impedance loudspeaker used in the Fog Horn may be slightly more difficult to get than a low impedance type but most suppliers we spoke to indicated that they stock one. The 75 ohm type was not as common as a 40 ohm variety although either should do equally well. All the suppliers we contacted, except one rather large one, stock some sort of tuning gang and ferrite rod suitable for the crystal sets and the solar powered radio.

Interest in the **ETI 142 High Current Power Supply** from both readers and professional organisations has been astounding. Supply of two components has been somewhat less than astounding though! After a call to Philips' new NSW Sales Manager, Robert Arthur, we are reliably informed that the BYX30-200R diode is now available through their semiconductor agents Cema and A&R Soanar. The ferrite cores FX3740-4322 (020 52520) and bobbins DT2740-DT2743 will be stocked by their ferrite and passive components agent, George Brown of Camperdown in Sydney.

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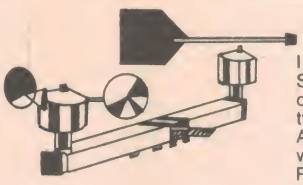

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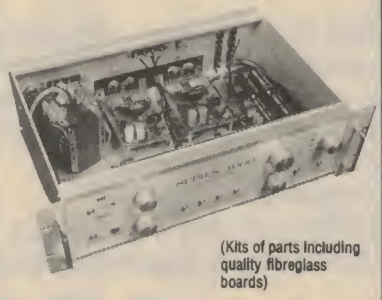

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Gutter mount	2 metre stub	6 & 2 metre antenna	80 metre antenna	40 metre antenna	20 metre antenna	15 metre antenna	10 metre antenna
Cat D-4100	Cat D-4102	Cat D-4104	Cat D-4110	Cat D-4112	Cat D-4114	Cat D-4116	Cat D-4118
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F.A.C.T. Symposium goes 'international'

With a small contingent of enthusiasts from New Zealand, led by Vaughn Henderson ZL1TGC, and Noel Spalding P29GA from Lae in Papua New Guinea, the 1979 F.A.C.T. Symposium took on an 'international' flavour.

The Symposium was held over the long weekend, 29-30 September to 1 October, at Noah's Northside Gardens Hotel in North Sydney. This year's theme was "Propagation and circuit techniques'.

Vaughn, ZL1TGC, is the VHF contributing editor to "Break-in", the NZART's journal. Together with his cohorts, Vaughn returned to New Zealand vowing to start up a similar amateur event over there. Good luck to them!

The series of nine lectures were well received by all accounts, question times generating some enthusiastic discussions, and not a few thorny questions. The first lecture, given by Keith Gooley VK2BGZ from the Ionospheric Prediction Service, on behalf of Dr D.G. Cole, gave us an insight into solar cycle prediction methods and a few clues on what the current cycle is doing.

The talk on "Amateur Microwaves", from Des Clift VK2AHC, a well-known worker in the field, brought forth a fascinating array of gear.

Mike Farrell's (VK2AM) paper on "Tropospheric Scatter Propagation on 144 MHz" showed what can be done with even quite modest equipment on 2m. His talk was supported by some interesting tapes of signals from stations over 300-500 km paths.

The Sunday morning sessions were set aside for the propagation research papers. Ken MacCracken, VK2CAX, delivered his paper first. "Radio Propagation from the Point of View of the Amateur" covered the interesting propagation modes available to VHF operators and referred to the work being done by the Project ASERT team. (Project ASERT is an amateur propagation research project that grew out of last year's Symposium.).

Ken's talk was well illustrated and stirred up some lively and fruitful discussion. A number of people have been recruited to the Project ASERT team — including Noel, P29GA — and it seems many new paths will be researched.

The Symposium organiser, Roger Harrison, VK2ZTB, delivered two papers on trans-equatorial propagation. One concerned his own research into TEP contact on 144 MHz between Darwin and Japan. The other paper was delivered on behalf of Mal Heron from James Cook University of North Queensland on 'TEP on VHF via ionospheric bubbles'. This paper covered the recent research work on a very interesting phenomena that amateurs discovered and have helped research — and still could.

Sunday afternoon's session was given over largely to Jeff Pages and John Sheahan (VK2BYY and VK2ZPC) who gave a very practical demonstration of "Using Microprocessors in Amateur Equipment". They showed off the Sydney Channel 8 repeater 'housekeeping' gear and some very interesting foxhunting equipment — with a proven record of wins!

The final sessions on Monday morning saw Jonathan Scott, VK2YBN, deliver his paper on "Computer Aided Circuit Analysis and Design". This paper threw up some interesting discussion.

Unfortunately, Rex Pearson, VK2AIP, was ill and unable to present his paper, but a short discussion of the topic, solid-state linear power amplifiers, was held.

Reviewing the event, it seems to have been quite a success, despite a smaller turnout than last year. There were more interstate registrations this time — plus the already mentioned overseas attendees. Everyone demanded a 1980 Symposium and planning is currently under way.

Printed copies of the "Proceedings" should be available by the time this appears. They will be distributed free to those who attended. If you couldn't come, but would like a copy, they are available for $6.50, post paid, from ETI, 15 Boundary St., Rushcutters Bay, NSW 2011. Copies of the 1978 "Proceedings" are also available at $5.50, post paid.

Major sponsor for the 1979 F.A.C.T. Symposium was Electronics Today International; other sponsors were The WIA, NSW Division and Ansett Airlines.

Mike Farrell, VK2AM, delivers his paper (pic: VK3OT).

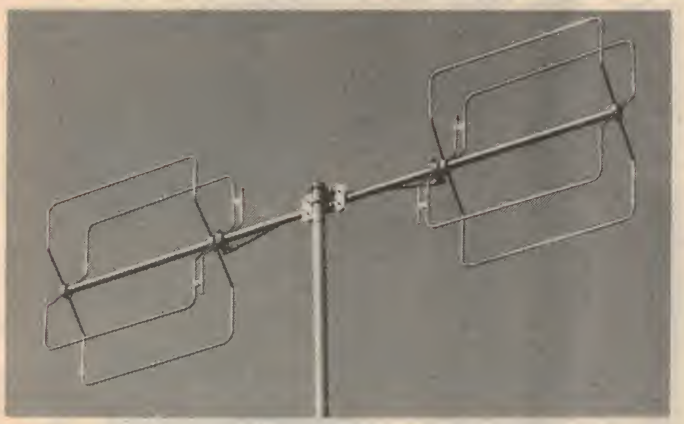
The great Gosford Field Day!

It's on again! What is surely Australia's largest amateur radio gathering — the Gosford Field Day — hosted by the Central Coast Amateur Radio Club, will be held on Sunday, 17 February 1980 at Gosford Showground, Showground Rd, Gosford, the usual venue.

All the usual fun-filled events will be on again: HF and VHF scramble, 28 MHz and 146 MHz foxhunts, surplus auction, equipment displays and sales etc, etc. You can take a picnic lunch or buy food from the take-away bar on-site. 807s will be available as usual.

For more details, programme etc, contact the Secretary, CCARC, PO Box 238, Gosford, NSW 2250.

COMMUNICATIONS



Famous Swiss Quads available here

The high-performance Swiss Quad style of antenna is well known for its good front/back ratio, deep side nulls and 'clean' pattern.

Invented by a Swiss amateur, HB9CV, the concept is to drive both reflector and radiator, phased so as to produce an 'end-fire' array. Claimed gains and front/back ratios are generally higher than for conventional quads.

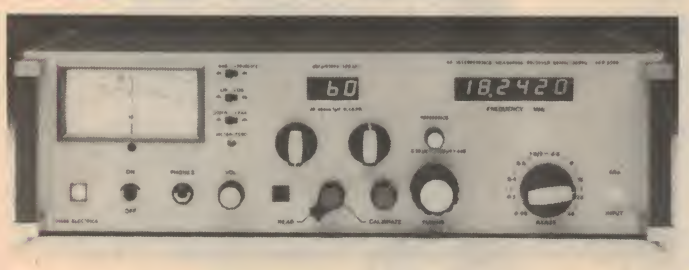
Commercially-made units, manufactured by TET of Japan, are available in Australia through the importers, GFS Electronic Imports.

Models for 10 and 15 metres have been available for some time — the SQ-10 and SQ-15.

New to the range are some six and two metre models. The SQ-61 is a single unit for six metres. The two metre models are the SQ-22 and SQ-24. The first consists of two, separate phased quads to improve forward gain, while the SQ-24 is a stack of four to give high gain.

The SQ-15 is priced at $169, the SQ-10 $159, the SQ-61 $119, the SQ-22 $99 and the SQ-24 $219.

Full specs and further information is available from GFS Electronic Imports, 15 McKeon Rd, Mitcham Vic 3132; (03) 873-3939.



Interference measuring receiver

The HFR 2000 is a precision RFI measuring receiver for the measurement of conducted and radiated interference within the frequency range 150 kHz to 30 MHz in accordance with CISPR 1 for quasi-peak measurements.

Direct peak measurements can also be made.

The instrument has been designed for ease of manual operation. Push button calibration and compensated output display reduces operator error.

An optional facility allows automatic recording of attenuation and frequency when connected to an external printer.

For further information please contact: The Dindima Group Pty Ltd, PO Box 106, Vermont Vic 3133.

UK looks at land mobile

The British Home Office has announced its intention to start trials next year comparing VHF land mobile operations using SSB on 5 kHz channel spacing with FM on 25 kHz channel spacing and with AM or FM on 12.5 kHz channel spacing.

This decision follows a successful demonstration earlier this year of the Philips/Pye VHF SSB system (see July ETI, p. 152).

The Home Office say that investigations have arrived at a stage where field trials will be useful, but that this doesn't imply any commitment by them to SSB.

Apparently, another option open to them is the 'spread spectrum signal' technique. This is being investigated at Leeds University on a grant from the Home Office.

This technique allows a spread-spectrum transmission to share a channel with other types of transmission — television for example.

It promises better utilization of a multi-plexed communications channel. The system uses a pseudo-random subcarrier modulated by the baseband (i.e. voice) information. This produces a noise-like signal over a wide range of frequencies (hence the term — spread spectrum).

The system allows operation with signal/noise ratios less than unity. At the receiving end, the baseband information is recovered by cross-correlation with a locally-generated pseudo-random carrier corresponding to that transmitted.

This system needs considerably more development before it can compete commercially with currently-available transmission techniques.

Replacement microphones

To provide dealers and installers with a series of popular replacement microphones for two-way land mobile transceivers, Turner have introduced their 'Landcom' series of microphones.

Competitively priced, Turner's microphones are high quality and match the manufacturers' specifications.

Mobile types are plug-to-plug compatible with original equipment; have high impact cycolac cases, colour standardized throughout; include cables terminated (on most models) with female slide-on lugs for ease of cable replacement and have heavy duty neoprene coil cord with four conductor, standard 24 gauge wires colour coded as OEM.

All use a dynamic insert for voice intelligibility and a quality sound.

Noise cancelling amplified dynamic versions of the most popular models are offered for areas with a high ambient noise level.

Also available is a weather-resistant microphone for extremely rugged applications.

Five models of base station microphones are offered and are compatible with most major manufacturers' consoles. (Motorola, GE, RCA, etc) Three models of Desk microphones offer the user a straight dynamic, non-amplified version for use with or without a remote preamp. An amplified dynamic version low impedance desk microphone and the same version with a private line squelch monitor function are also included in the range.

Two versions of the new Turner SE22000 series mics with cardioid interiors were recently released, intended for use on 'gooseneck' booms. The model LMB-4 comes with gooseneck and momentary SPDT PTT switch. This separates from the gooseneck using a standard four pin connection. The LMB-5 is the same microphone but comes with two-metre four conductor coil cord, four pin connector and mic holder.

For more information, contact: The John Barry Group, 105 Reserve Rd, Artarmon, NSW; (02) 439-6955.

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Model 747

* 16 Channels
* AC/DC Operation
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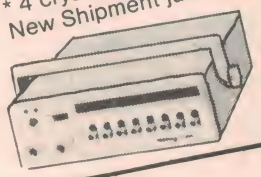

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Like Icom, Leader, Kenwood — to drop only a few of our top names. At Vicom, you'll find not only Australia's largest range of communications gear — but all the best-known names in this field from around the world. Check out our international Line-up today!

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KENWOOD R-1000 COMMUNICATIONS RECEIVER

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VHF & UHF POCKET RECEIVERS

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Normally $132
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Modulation 2KHz Sine
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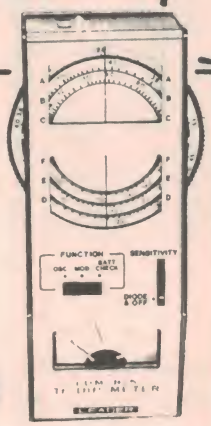
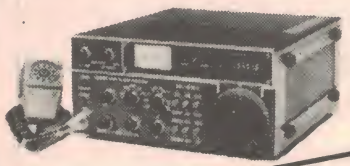


100 WATTS ON 6 METRES
New IC551D 100W Model

$850 ICOM



LSG 16 RF SIGNAL GENERATOR

100KHz-100MHz Solidstate RF signal generator. Suited for aligning the IF circuits in AM, FM and TV sets.

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— What the home video market was missing!

* Black & white with 4:1 zoom.
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Includes its own power supply unit
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Yes, more than 2000 IC22S have been sold in Australia! Surely a mark of success for this superb rig.

IC22S 2MFM: STILL $299

27MHz Marine Transceivers

AC516 ANA incl. one channel — $126.00

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CX-2L 1.8-170 MHz, 100 w pep — $45.00
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SWR/PWR Meters

VC2 Popular twin meters, 3-150 MHz — $35.00
SWR200 Oskerblock, 3-200 MHz — $86.00
CN620 Daiwa, cross-needle type, 1.8-150 MHz — $99.00
CN630 Daiwa, 140-450 MHz, direct read — $135.00

Cameras

EX-803 B&W, handheld with 4:1 300m — $414.00

Plugs & Sockets

BNC Plugs $2.80
BNC Jumper leads $6.20
BNC Chassis Sockets $2.80
BNC "T" adaptor $5.60

2m Bi-Linears

MR900E Tono, 80-90w incl. Rx preamp — $289.00
MR1300E Tono, 120-B&W incl. Rx preamp — $350.00

Kenwood Transceivers

TS520S HF transceiver — $635
TS120S Solid state 100w — $735.00
TS120V Solid state 10W — $600.00
TS180S Solid state 10w — $1240.00

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VM-1 Noise cancelling, hand ptt, low z — $10.00

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RG58AU mil spec. 30m reels — $13.00
RG213/U mil spec. per metre — $1.40

ICOM Gear

IC701 transceiver NOW — $1199.00
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IC551 6m transceiver — $799.00
IC280 2m fm remotable — $450.00
IC502 6m ssb portable — $239.00
IC202S 2m, ssb portable — $318.00
IC211 2m all mode — $847.00

Morse Keys

HK702 Deluxe Key with marble base — $41.00
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Radio Teletype Terminal

0-7000 Tono RTTY CW/Baudot/ASCII — $839

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Africa number one

The West African state of Gabon has begun test broadcasts from powerful new transmitters at Moyabi, near Fraceville.

The new shortwave broadcast centre consists of four units of 500 kilowatts each, with power supplied by the centre's own power station, completed at a cost of some 13 million francs.

The four high power transmitters have been in place for many months, but test broadcasts were delayed by a shortage of funds needed to make the Moyabi centre operational.

The Gabon Ministry of Finance sought to delay until 1980 the release of vital funds to put Moyabi on the air, while the transmitters were housed insecurely in uncompleted buildings.

The Ministry of Information realised the urgent need to put their expensive electronics equipment into use in order to prevent serious transmitter deterioration. To achieve this, Gabon has formed a company to manage the Moyabi shortwave centre, with the government taking a 50% capital holding. The rest of the capital for the management company has been supplied by Radio France International and various French companies.

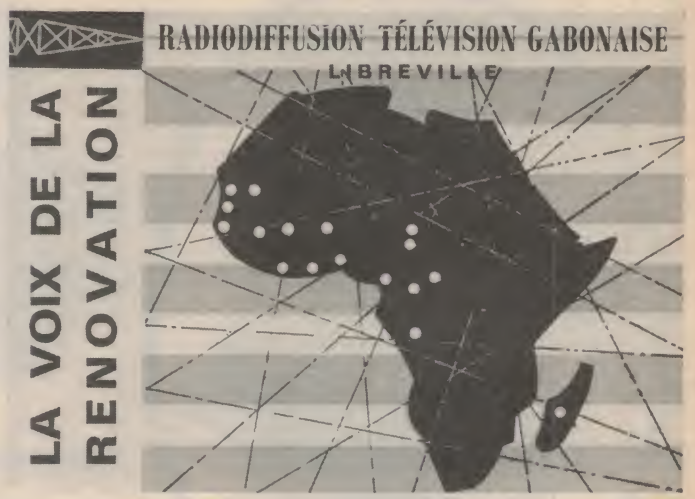
The management company of Moyabi is known as "Africa one".

With finance now available, transmissions from Moyabi have been on air since late in September. Some frequencies well heard in Australia include: 11 945 between 0500 and 0800; 15 200 0600-0900; 9710 0400-0600; 21 495 0800-1200. Transmissions have also been carried out in the 1300 to 2100 period, during our early mornings.

The test broadcasts use the company name as identification, using the slogan "Africa number one on the air". Programmes consist of African and western music recordings, interspersed with frequent identification announcements given in English, French, Spanish, Arabic, Swahili and Portugese. The station frequently asks for reports of reception conditions, and these reports may be sent to: Africa number 1, Mailbox 1, Libreville, Gabon. DXers reporting reception of the Moyabi test transmissions have the chance to win many prizes, including a Peugeot motor car!

It is likely that Radio France International will make use of the Moyabi facilities in the future for relays of Paris programmes directed to Africa. Radio France International broadcasts primarily for an African audience, and has long been seeking such a relay station in order to compete with other international broadcasters with relay transmitters on or near the African continent, such as Voice of America (with a relay station at Monrovia, Liberia), The Voice of Germany (Kigali, Rwanda), and the BBC (on Ascension Island). A recent press statement by the Gabonese President indicated the government's hope of selling time on the Moyabi transmitters to Radio France International.

With the activation of the 500 kilowatt Moyabi units, Gabon joins the growing list of Third World countries determined to have their voice heard on the international shortwave bands so long dominated by the broadcasts from the superpowers and European countries.



Powerful clandestine in Asia

Probably the best heard of the numerous Asian clandestine stations at present is the Voice of the Malayan Revolution.

Operated by the Malayan Communist Party, the transmitters are located in south China, and the station has a daily English programme on 11 830 and 15 790 from 0930. Broadcasts are hostile to the present Malaysian Government and report on guerilla activity in peninsular Malaysia.

World Radio and TV Handbook

The ARDXC is co-ordinating Australian orders for the 1980 edition of the WRTVH which will be published in Denmark early next year.

The WRTVH is the top reference for shortwave enthusiasts, with latest schedules for almost every station you may hear on the broadcast bands.

The fastest way to receive your WRTVH 1980 is by obtaining an order form from ARDXC. Orders will be sent by registered airmail direct from the Danish publishers to your door by early February.

Voice of Philippines re-activates

Radio Philipinas, Voice of the Philippines in Manila, has returned to the airwaves, using a 50 kilowatt transmitter on 9578.

The station is operated by the National Media Production Centre, and is on air in our local evenings from 0700. Signals suffer interference from adjacent more powerful stations. Programmes are directed to East Asia from sign-on until 0955, to South East Asia until 1155, to Indo-China 1157-1355, to North America 1357-1655, and to Europe 1657-1855.

The Voice of Philippines service to South East Asia includes a major news bulletin in English at 1000.

NOTE! All times are given in Greenwich Mean Time (GMT). To convert GMT to Australian Eastern Standard Time, add 10 hours. To convert to Central Time, add 9 hours, and for Western Time, add 8 hours. All frequencies are in kHz.

Compiled by Peter Bunn, on behalf of the Australian Radio DX Club (ARDXC). Further information on DXing or the activities of ARDXC may be obtained from either PO Box 67, Highett, VIC 3190, or from PO Box 79 Narrabeen, NSW 2101, for a 30c stamp.

PREDICTIONS

JANUARY 1980

Covering 3 to 40 MHz, these predictions show the times radio contact is possible between the areas designated beneath each graph, as well as the possible 'mode' and reliability. Vertical columns indicate time — commencing at 0000 UT on the left, to 2300 UT at right. For reliable predictions follow the times and frequencies indicated by the F character.

Complete information on using these predictions can be obtained by sending a stamped, self-addressed envelope to:-

ETI — Predictions
3rd floor 15 Boundary St
RUSHCUTTERS BAY NSW 2011.

These GRAFEX style computer generated predictions are provided courtesy of the Australian Ionospheric Prediction Service.

KEY TO SYMBOLS

A blank area means no normal propagation is possible.

% . . . . . path open 50 - 90% of days in month.

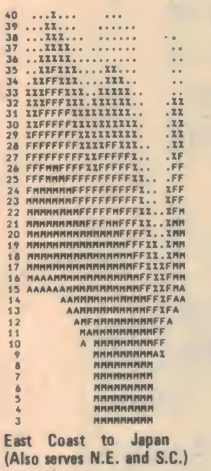
F . . . . . path open at least 90% of days in month.

B . . . . . propagation possible via E and F layers over 90% of days. Overrides 'F'.

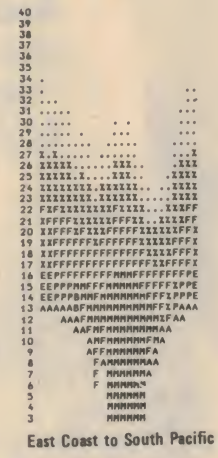
M . . . . . propagation possible by both 1st and 2nd F-layer modes. Expect strong fading.

S . . propagation possible by 2nd mode (also 3rd and mixed E and F modes). Expect strong fading, weak signals.

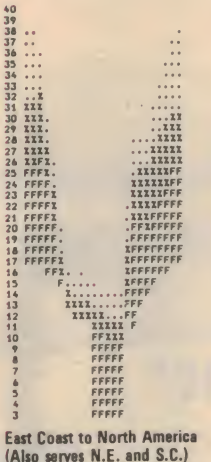
A . . . . . .High absorption indicated. Expect weak signals.



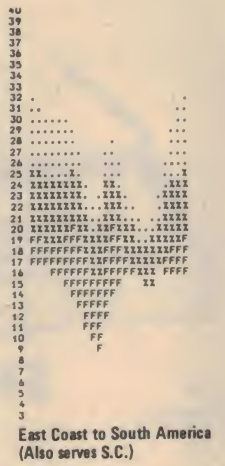
East Coast to Japan (Also serves N.E. and S.C.)



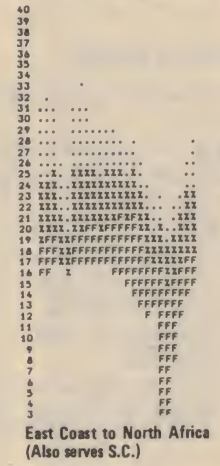
East Coast to South Pacific



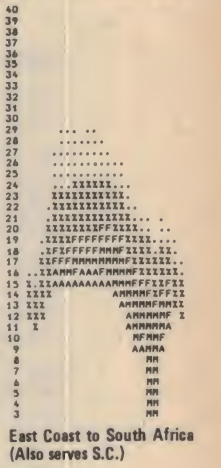
East Coast to North America (Also serves N.E. and S.C.)



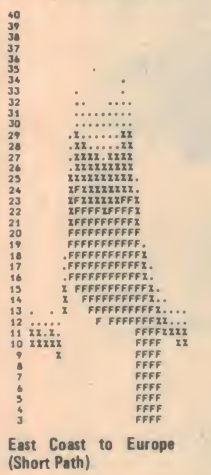
East Coast to South America (Also serves S.C.)



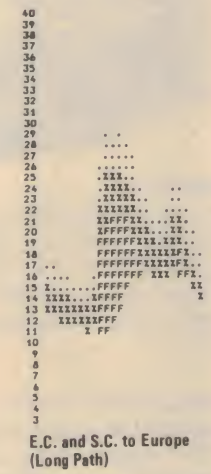
East Coast to North Africa (Also serves S.C.)



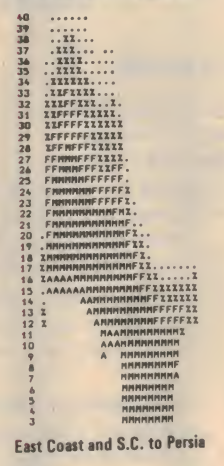
East Coast to South Africa (Also serves S.C.)



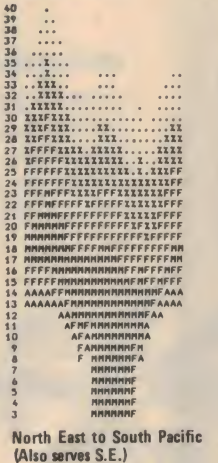
East Coast to Europe (Short Path)



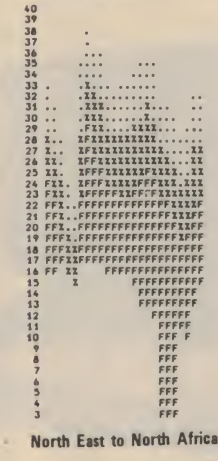
E.C. and S.C. to Europe (Long Path)



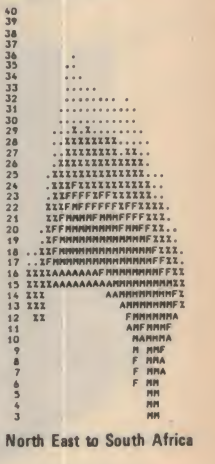
East Coast and S.C. to Persia



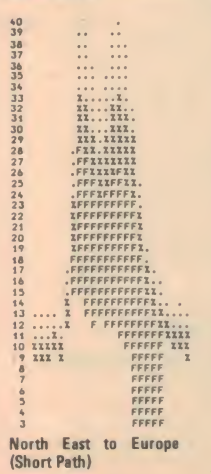
North East to South Pacific (Also serves S.E.)



North East to North Africa

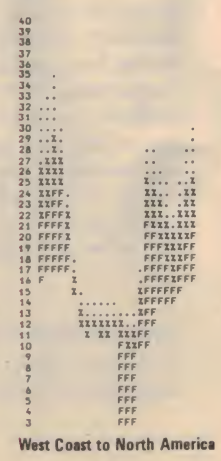


North East to South Africa

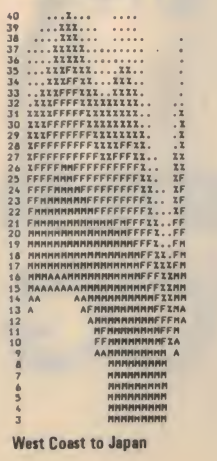


North East to Europe (Short Path)

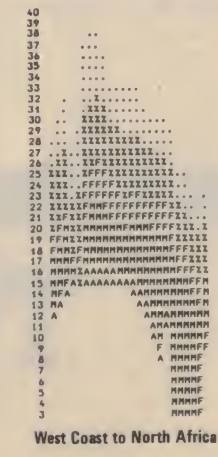
S. Central & W.C. to Europe (Short Path)



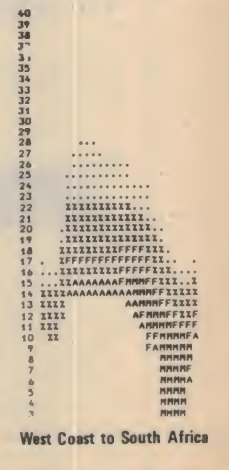
West Coast to North America



West Coast to Japan



West Coast to North Africa



West Coast to South Africa

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Superboard II – a complete system on a board requires a 5 volt supply to be up and running.
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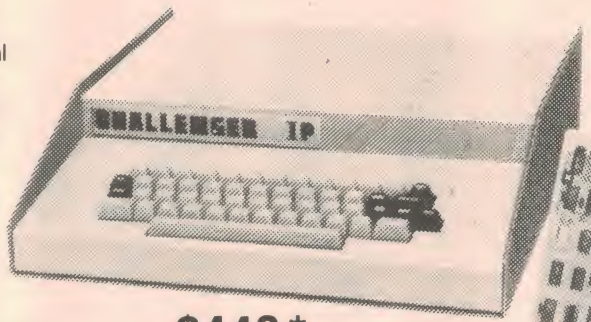
Both systems feature a 24 x 24 character display, 4K RAM on the board, Keyboard and ready-to-run BASIC-in-ROM.
Challenger I's are expandable with up to 32K of RAM, dual mini-floppies, and printer.



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TV set and cassette recorder not included.

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All systems include 4K RAM, a typewriter style keyboard, video output suitable for use with an RF convertor (not supplied) to a standard TV set, and the reliable Kansas City standard cassette system. Microsoft's 8K BASIC-in-ROM avoids lengthy loading from cassette and features full string manipulation, floating point and trigonometric capabilities. A machine code monitor in ROM, plus an Assembler allow access to machine code programming. A large range of programs are a available for education and entertainment.
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Computerware
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Phone (03) 68-4200.
W.A.
Micro Data Pty Ltd
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EAST PERTH. WA 6000
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Micro Solutions
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SUBIACO. WA 6008
Phone: (09) 381-8372
Compulator Australia,
Cloisters Square,
863 Hay Street,
PERTH. WA 6000
Phone: (09) 321-9232
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The Electronic Circuit,
Suite 414,
Fashion Valley Building,
20.Duncan Street,
FORTITUDE VALLEY. QLD 4006
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Applied Data Control,
244 Glen Osmond Road,
FULLARTON. SA 5065
Phone: (08) 79-9211
Neil Pollard
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a micro computer without S100 Bus compatibility is like a coat hanger without a hook

NOTE! ALL PRICES INCLUDE TAX!

The Exidy Sorcerer is a complete stand-alone microcomputer, needing only a video monitor or modified TV set to be up and running in full BASIC.

But the Sorcerer is more: change the plug-in ROM PAC™ and it will communicate in other languages, add the S-100 Bus expansion and have access to other manufacturer's peripherals - plus, plus, plus. The Sorcerer is a complete dedicated computer.

SORCERER

Cat. X-1190 8k Memory	Cat. X-1192 16k Memory
$1095	$1250

P&P $5.50 per unit

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FROM $1095*

look at our prices for peripherals

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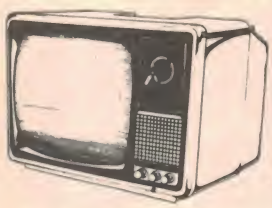
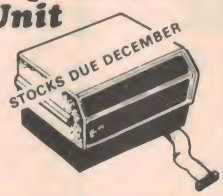


Suits Sorcerer, Tandy TRS-80, Apple etc.

Why waste money on overpriced monitors? This famous make unit has large 30cm diag. screen plus it simply connects to your computer via an RCA socket. 240V AC or 12V DC operation.

$149.50 X-1196 P&P $5.50

S-100 Expansion Unit



Use other manufacturer's peripherals with your Sorcerer & S-100

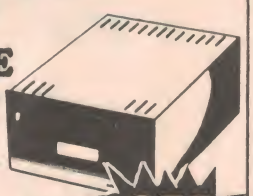
For the serious computer owner. Contains powerful computer power supply plus buffer/interface circuit to protect the computer in case of damage to the S-100. Plus many more benefits.

$499 X-3010 P&P $5.50

Floppy disc drives

SINGLE

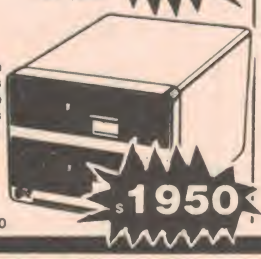
Micropolis single unit with 143k storage plus improved drive system. Dual density & complete with all bits and pieces.



DUAL DENSITY X-3200 $875 P&P $5.50

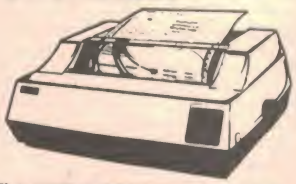
DUAL

Micropolis drive with 630k storage. Takes hard centre diskette and comes with all bits and pieces.



QUAD DENSITY X-3210 P&P $5.50 $1950

C-ITOH PRINTER



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Melbourne Home Computer Show

The Home Computer Shows held in Melbourne and Sydney by Australian Seminar Services continue to go from strength to strength. The latest 'Home and Small Business Computer Show', held at the Exhibition Buildings in Melbourne from the 27th to the 30th of September proved to be a tremendous success with 59 booths and an attendance of 17,400 people.

Several new products were released at the show:

ASP Microcomputers, 799 Dandenong Road, East Malvern Vic 3145, (03)211-83-4; released a system based on a new bus which is an extension of the Z-80 architecture. The Z-80 CPU also carries a 2716 programmer, 1K of RAM, up to 8 K of PROM and a parallel interface. An 80 x 40 video display, double density disk interface (16 K RAM cards are also available), and the computer will support CP/M and compatible software.

Adaptive Electronics, 77 Beach Road, Sandringham Vic 3191, (03)598-4422; announced their Adaptel S-100 computer, which integrates an 80 x 25 video terminal with display, keyboard and S-100 motherboard in a single attractive cabinet. The motherboard can be stocked with Cromemco cards from Adaptive.

Anderson Digital Equipment, PO Box 322, Mt Waverley Vic 3149, (03)543-2077; displayed the Compucolour II personal computers. Two units are available, both with BASIC in ROM; the Model 4 has 16 K of user RAM, while the Model 5 has a 32 K user space. Both have an integrated colour CRT, keyboard and minifloppy.

Dick Smith announced the System 80, a Tandy-compatible microcomputer, for which all of our readers must have seen the ads by now!

Systems Automation Pty. Ltd, 26 Clarke St, Crows Nest NSW 2065, (02)439-6477; displayed their latest Ohio Scientific home computer, with ac control and sound outputs, as well as the C3-C running under Ohio Scientific's level 3 operating system, which offers real-time multitasking capabilities with up to 16 terminals on-line.

There were lots of other products on display; sadly we don't have the space to go into them here.

A very successful seminar programme was conducted in conjunction with the show, covering several subjects from 'Careers in Computers' to 'Computers as a Teacher in the Home'.

The next Home and Small Business Computer Show will be held in Adelaide in March 1980, followed by the Sydney Show at the Westco Pavillon, Showground over 22-25th May 1980.

CP/M for Heath

Those owners of Heath H8s with the H17 disk system who have regarded with envy their fellow computerists who are able to run CP/M and all the software that is compatible with it — can breathe easily at last.

Lifeboat Associates who have done such a good job of converting CP/M to run on other systems (the North Star, for instance) have released a version of CP/M compatible with the H17 and H89 disk systems.

The modified CP/M will run on systems configured for Heath's HDOS operating system, and will run most of the programs available to standard CP/M.

Many computer stores will probably have this available soon, but if you can't get hold of it locally, contact Lifeboat Associates, 2248 Broadway, New York, NY 10024, USA.

New Sydney store

A new computer store is being opened by Acoustic Electronic Developments to handle their S-100-related products.

The store, at 123 Military Road, Guildford, (Tel (02) 632 6301), will stock AED's microcomputer cases, power supplies, CPUs, disk interfaces and other S-100 type products, as well as software such as CP/M.

The store is backed by AED's comprehensive service department and factory at 179 Military Road, Guildford. AED will provide special consultancy and design services to business and industrial microcomputer users and are planning to run starter seminars for technicians and engineers on Microcomputer Techniques in Industrial Control.

An interesting new product from AED is their intelligent keyboard interface which connects between a keyboard and a computer, providing such advanced features as allocation of any code to any key. The extra keys on a Honeywell or similar keyboard can be assigned predefined strings, such as BASIC keywords or editor commands, and the keyboard operator can assign any key to any code or string through a user-definable string facility. Two versions of the board are available with custom programming virtually 'off the shelf': a 203 x 102 x 19 mm card which can fit in the keyboard enclosure or an S-100 card to go in the computer cabinet. AED announce the availability of three S-100 power supplies to suit their MPS-01 microcomputer cabinet (see this column, March 79). Both 10 A and 20 A supplies are available, as well as a 20 A version which also provides supplies for a pair of floppy disk drives.

SWTPC 6809

GFS Electronic Imports have written to advise us that they have been appointed Victorian distributor for Southwest Technical Products Corporation (SWTPC), manufacturers of computer systems based on the Motorola 6800 and 6809 microprocessors.

Systems range from hobby level machines (assembled or kit) up to professional systems with full software backing to suit business and technically oriented users alike.

The 'mainframe' is the MP/09, based on the extremely powerful 6809 chip, and is supplied with 56K of memory which can be expanded to 384 Kbytes if required. A compatible intelligent terminal, the CT-82, is based on Motorola 6802.

Amateur radio application software is also available: for example, one package allows the user full RTTY facilities on his 6800 or 6809 computer. GFS also expect to have similar software available shortly that will bring Morse Code facilities to the 6800 or 6809.

For further information, contact GFS Electronic Imports, 15 McKeon Road, Mitcham, Vic 3132. (03) 873-3939.

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NEW

C100 Illustrated

Announcing the
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from U.S.A.

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(With printer from $4,950)
- Z80 CPU
- 48 KB Memory
- 2 X 143 KB Floppy
- 1 X RS232
- 1 X Parallel printer port
- S100 Bus edge connector

- **With business Software at slightly extra cost**
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- Creditors
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C200 SERIES
- Z80 CPU 4MZ
- 2 X 315 KB Gloppy
- 64 KB Memory
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- 2 X Parallel Ports
- Multi User/Multi Tasking
- Hard disk

FROM $5,400

C300 SERIES
- Multi Processor (7 Micros)
- Multi User/Multi Tasking
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- DMA
- 1 MB Floppy
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FROM $14,500

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THE BASE 2 MODEL 800 IMPACT PRINTER

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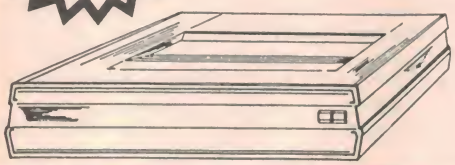

SPECIAL
$695
Inc. options "M" & "T"
Usually
~~$895~~

UNIT PRICING
standard MODEL 800....$695
option "M" $100
option "S" $100
option "T" $100
(by the time you read this, Base 2 will have commenced volume shipments of the MODEL 800. We regret that we cannot accept responsibility for any inconvenience this causes our competitors).
SPECIFICATIONS
OPTIONS: "M" — 2K RAM buffer, "S" — high speed paper advance and graphics "T" — tractor feed.
PRINTING METHOD: 7 Wire dot matrix, bi-directional, impact
PRINT AREA: 8.0 inches (203mm)
THROUGHPUT SPEED: 60 lines per minute
LINE SPACING: 6 lines per inch
COLUMN CAPACITY: 72,80,96,120 or 132. Switch or program selectable
CHARACTER HEIGHT: .104 inches (2.6mm)
CHARACTER WIDTH: .08 inches (2.0mm) at 80 col
PAPER WIDTH: 9.5 inches maximum
RIBBON: .5 inch (13mm) cartridge (5M chars)
INPUT/OUTPUT PROVISIONS: **a) RS-232, b) 20 ma current loop, c) IEEE — 488 type, d) Centronics parallel.**
SIZE: 3 inches high (75.2mm), 10 inches deep (254mm), 14 inches wide (355.6mm).
WEIGHT: 9 pounds (4.1 kg.)
OPERATING CONDITIONS: 40 to 120 degrees F (4-49C), 10 to 90 percent relative humidity
POWER: 115 VAC or 230 VAC (switch select) 50 or 60 Hz
EXTERNAL CONTROLS: Power on-off, self-test, baud-rate, line buffer length, 10 mode select.
BAUD RATES: Fifteen rates from 110 to 19,200
CHARACTER FONT: 5 X 7 96 character ASCII
LINE BUFFER: Two lines plus space for second character font

S100 BOARDS
- CPU CARDS
- MEMORY
- DISK CONTROLLER
- SERIAL & PARALLEL
- S100 FRONT PANEL

SOROC IQ120
- Cursor control keys
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- Line and page erase
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T1810

All quoted prices are exclusive of 15 percent sales tax.

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In Boxes of 10.
FLOPPY DISCS (5") **$4.00 ea.**
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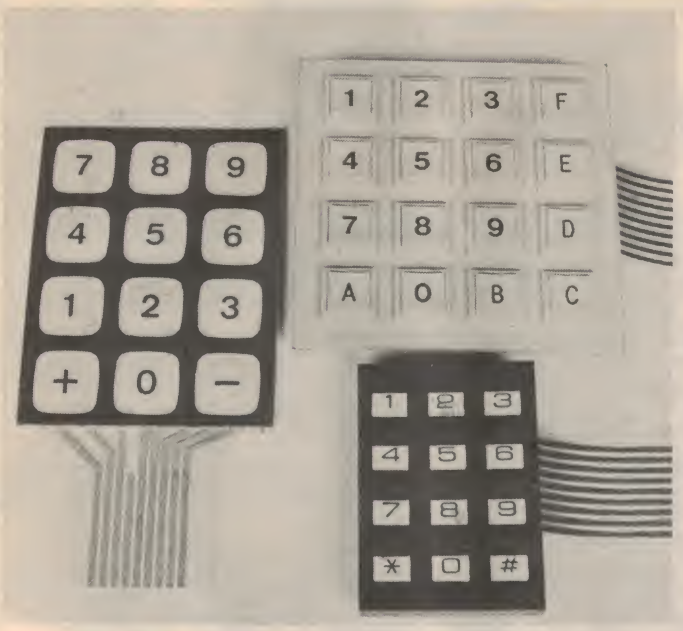
26th Floor, 100 Miller St, Nth Sydney (02) 436-1600.



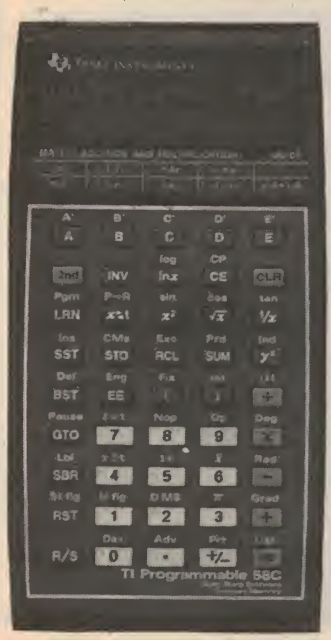
New keyboards

Amtex Electronics have announced a number of new Chomerics keyboards now available in Australia.

The EH models comprise standard 12 and 16 key keyboards, available with or without bezels or edge frames. The keys are hinged in a plastic frame, and can be two-shot or one-shot moulded. Legends for one-shot keytops can be supplied in the form of an adhesive-backed printed overlay.

Chomerics' Model FR is a low cost, low profile keyboard, made of laminated one-piece flexible circuits and flexible legends. Interconnection is by means of a flexible tail which is an extension of the circuit. Adhesive backing provides simple mounting.

Further details are available from Amtex Electronics, P.O. Box 285, Chatswood, 2067. (02) 411-1323.



New calc from TI

Texas Instruments are following up on the success of their Programmable 58 and 59 calculators by announcing a version of the 58 with CMOS memory so that the contents of the memory are continuously preserved.

The TI Programmable 58C has the same facilities as the 'straight' 58, including plug-in ROM modules of programs, 480 program steps, or up to 60 memories.

The library of Solid State Software modules which complement the 58/58C/59 has also been expanded recently to include Electrical Engineering, Agriculture, Leisure Library and an RPN Simulator.

Apple II meets IEEE bus

The General-Purpose Interface Bus (GPIB), also known as the Hewlett-Packard Interface Bus, or IEEE Standard 488-1978, is a bus which can be used to connect together various types of instruments, along with plotters, printers and the like, to function as a complete test system under the control of a computer or desk-top calculator.

The bus is a bit-parallel, byte serial interface with eight control lines on which devices are nominated as either talkers (a voltmeter, for example), listeners (a printer, perhaps) or controllers (such as a computer).

To date, the major 488 bus controllers have been desk-top calculator/computers such as HP's 9825 or 9845, or the Tektronix 4051. Now, here's a rival, in the form of the Apple II personal computer plus a new bus interface card from Kalyn Peripherals, PO Box 144, Pennant Hills, NSW 2120.

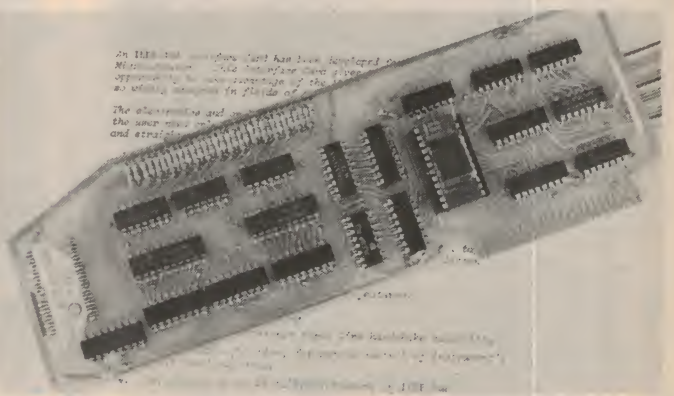
The IE-01-79 has on-board firmware to handle all bus handshake operations automatically and so requires no extra machine code software or memory space to operate.

The card allows the Apple II to function as a bus controller, talker or listener, and features the remote enable function. It will operate in any slot except zero and the bus facility can be easily invoked from BASIC by the familiar PR n command.

The use of discrete CMOS and LS TTL results in a total power consumption one third that required for currently available LSI IEEE 488 interface chips, and so does not severely compromise the use of other Apple peripheral slots.

Further information from Kalyn Peripherals.

P.S. Yes, we do know about the PET's 'IEEE 488' interface — no, no comment.



IBM Colour display

The daddy of them all, IBM, has released a new colour graphics display terminal, designed to enhance the presentation of business data.

For example, colour can be used to call operator attention to inventory shortages, credit limits or approaching deadlines (great for journos!).

The 3279 display station provides seven-colour capability and enables users to create their own programmed symbols for codes and type faces. A presentation graphics facility enables the display of graphs and charts.

Two models are available, each with either four or seven colours, and with 24 x 80 or 32 x 80 display capability.

To match the 3279, IBM have also released a new four-colour printer, the 3287, which uses a replaceable four-colour cartridge ribbon. Two models are available with speeds of 80 cps and 120 cps, and the printers have a programmed symbol feature, which allows customers to use and create up to four additional character sets.

All of which points to one thing — the giant is only sleeping!

NEW! 6809 EXORCISER COMPATIBLE MODULE

Designed and manufactured locally for Semcon

Features:

- MC6809 1 MHz CPU
- Fully buffered bus
- Two 6821 PIA's
- Two 6850 ACIA's with RS232 interface (One ACIA may be replaced with a 6852 S.S.D.A.)
- 4K static RAM accessible by external devices
- 4 sockets for up to 16K of EPROM (accepts 2708, 2716, 2516, 2532)
- O.S.9 in EPROM — this Unix based operating system written by Microware comes supplied with each module
- Programmable timer
- Supports D.M.A. channel
- Capable of tristating module bus buffers when external access is not required
- Break detect
- Power on reset
- 14411 baud rate generator

$950 plus tax
($799 if purchased without O.S.9)

SOFTWARE SUPPORT

The following software for the 6809 should be available early November

- Macroassembler
- Editor
- C-Compiler

Prices on application

7932A 32K STATIC RAM MODULE

- Now outline compatible with Motorola Exorciser cards
- Only available assembled and tested
- Includes 100 hour burn-in and 12 months warranty

Features: • Page mode operation — allows system expansion to 1 Megabyte • Quality PCB with solder resist • Motorola bus compatible • Low power — 2.5 amps typical • 300nS access • Fully static operation • Buffered address, data and control lines • Power rails in grid network for improved noise immunity • 4 x 8K blocks — individually addressable, each write protectable, may be removed from address space if not required • Multi-phase operation — the module allows access during phase one and phase two — ideal for multiprocessing or DMA channels

32K.....$650.00	16K.....$430.00
24K.....$540.00	8K.....$320.00

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Send large SAE with 50c stamp plus $2.00 for our latest catalogue. This includes detailed information on:

- Microware Software
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- 6809 CPU Module.
- 32 K RAM Module.
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6800 SOFTWARE

FROM MICROWARE

SEMCON is now the Australian distributor of Microware Software.
It is available in the following formats:

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(A) A/BASIC COMPILER — This is a true 6800 Basic Compiler that converts programs written in BASIC, into fast, efficient machine language programs. Its output runs without a run-time package and is directly ROMable according to user defined memory assignments. It requires 8K of RAM and permits the user to call up and incorporate his own machine language subroutines. **CASSETTE $85. SWT $175. SSB $175. M-DOS $500.**

(B) A/BASIC INTERPRETER — This is a source compatible, extremely fast, Basic Interpreter implemented as an incremental compiler. Its specially extended syntax and memory assignment features make it especially suited to process control and systems programming. It may also be used as an alternative to the text editor to prepare input for the Compiler. **CASSETTE $85. SWT $95. SSB $95. M-DOS $300.**

(C) A-BASIC SOURCE GENERATOR — This optional extra to the compiler disc versions, results in the production of a complete assembly listing from the object code produced by the compiler. **SWT $65. SSB $65. M-DOS $175.**

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(E) LISP INTERPRETER — This list orientated language, featured in the August 1979 BYTE, is ideally suited to computer aided design, decisional logic and artificial intelligence. LISP programs have the capability of dynamically altering themselves making it an ideal language for programs that learn. **CASSETTE $90. SWT $95. M-DOS $275.**

(F) D2 UPGRADE KIT — This enables the D2 to communicate with an RS232 interface. **$45.**

(G) RT/68 — Supplied in a 2708 ROM, this monitor normally looks like MIKBUG to most progams. Its real power lies in its multitasking capabilities. When the system command is executed, it can supervise the execution of from one to sixteen tasks. Each task may be assigned a priority, time slice and state indicator. **$65.**

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- Retains all the versatility of display formats of the CRT01 as well as the logic to provide a stable flicker free display.

Price $350.

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- Double-sided ground & plus 5V
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CMS 9600 MC6802 CPU MODULE

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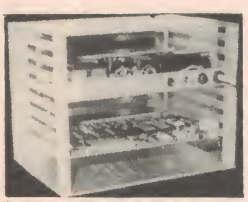
- Address and data buffers
- Power failure protect/restart
- MC14411 Baud rate generator

(One ACIA may be replaced with SSDA)

$565



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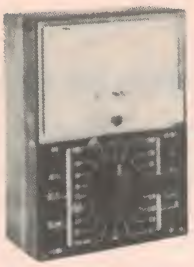
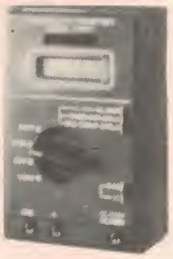


3003 A high sensitivity meter with fuse protection, taut band movement and mirror scale. A.C. current measurement up to 10A, and output terminal for dB readings.

D.C. VOLTAGE
Full Scale Value 0.25/2.5/10/50/250/1000V
Accuracy ± 3% of rated value.
Internal Resistance 30.000Ω/V
D.C. AMPERAGE
Full Scale Value 50μA/2.5/25/250mA/10A
Accuracy ± 3% of rated value
A.C. VOLTAGE
Full Scale Value 10/50/250/1000V
Accuracy ± 3% of rated value
Internal Resistance 13.500Ω/V
A.C. AMPERAGE
Full Scale Value 10A
Accuracy ± 4% of rated value
RESISTANCE (OHMS)
Full Scale Value 5k/50k/500k/5mΩ (Rc50Ω)
Accuracy ± 3% of scale length.
LOW FREQUENCY OUTPUT (DECIBELS)
Full Scale Value -20 + 36 dB.
Accuracy ± 4% of rated value.
DIMENSIONS
150 mm H. x 109 mm W. x 60 mm D. Weight 380g.
ACCESSORIES INCLUDED
Carry case, test leads, spare fuse, alligator clip.



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A "Field Effect" liquid crystal display ensures good contrast. Approx. 40 hours continuous use with alkaline batteries. Features include– automatic and fuse overload protection and semi automatic range selection.

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200 & 2000 mV ranges. acc. ± 0.3%rdg ± 0.1%f.s. ± 1dgt
20-200 Volts range acc. ± 0.5%rdg ± 0.1%f.s. ± 1dgt.
200 & 1000 V ranges acc. ± 1.5%rdg ± 0.1%f.s. ± 1dgt
D.C. AMPERAGE 4 ranges. With auto facility
200 & 2000 μA ranges acc. ± 1.0%rdg ± 0.1%f.s. ± 1dgt.
20 & 200 mA ranges. acc. ± 1.0%rdg ± 0.1%f.s. ± 1dgt
A.C. VOLTAGE 5 ranges. With auto facility
2000 mV range acc. ± 0.3%rdg ± 0.2%f.s. ± 1dgt
20-200 Volts range. acc. ± 0.8%rdg ± 0.7%f.s. ± 1dgt.
200 Volts range acc. ± 1.7%rdg ± 0.8%f.s. ± 1dgt.
1000 Volts range acc. ± 1.7%rdg ± 0.3%f.s. ± 1dgt.
A.C. AMPERAGE 4 ranges. With auto facility.
200 μA acc. ± 1.3%rdg ± 1.0%f.s. ± 1dgt.
2000 μA acc. ± 1.3%rdg ± 0.2%f.s. ± 1dgt.
20 & 200 mA ranges acc. ± 1.3%rdg ± 0.7%f.s. ± 1dgt.
RESISTANCE (OHMS) 6 ranges. With auto facility.
200 & 2000Ω ranges acc. ± 0.5%rdg ± 0.1%f.s. ± 1dgt.
20 & 2000kΩ ranges acc. ± 0.5%rdg ± 0.1%f.s. ± 1dgt.
2-20mΩ acc. ± 0.7%rdg ± 0.2%f.s. ± 1dgt
DIMENSIONS (Approx)
151 mm H. x 100 mm W. x 56 mm D. Weight 470g

MULTIMETERS

3001 A competitive meter with fuse protection, and an additional Battery Test Calibration facility for speedy checking of small batteries (calculators etc.) A temperature probe is available as an optional extra with a range of -50°C to +200°C.

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Internal Resistance 2000Ω/V
D.C. AMPERAGE
Full Scale Value 0.5/10/250mA
Accuracy ± 3% of rated value
Voltage Drop 250mV
A.C. VOLTAGE
Full Scale Value 10/50/250/1000V
RESISTANCE (OHMS)
Full Scale Value 3k/30k/300kΩ (Rc. 26Ω)
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ACCESSORIES
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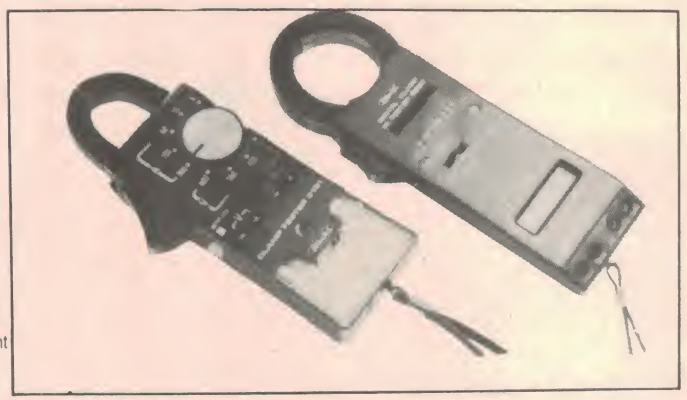
Accuracy ± 3% of rated value.
Internal Resistance 100.000Ω/V
D.C. AMPERAGE
Full Scale Value 10μ/100μ/1/10/100/500 mA./10A
Accuracy ± 3% of rated value
Voltage Drop 100 mV 250 mV
A.C. VOLTAGE
Full Scale Value 10/50/250/500/1000V
Accuracy ± 3% of rated value
Internal Resistance 10.000Ω/V
A.C. AMPERAGE
Full Scale Value 10A
Accuracy ± 4% of rated value
RESISTANCE (OHMS)
Full Scale Value 2k/200k/2m/20mΩ (Rc 20Ω)
Accuracy ± 3% of scale length
LOW FREQUENCY OUTPUT (DECIBELS)
-20 +36 dB
DIMENSIONS
170 mm H. x 126 mm W. x 70 mm D. Weight–690g.



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Accuracy ± 3% of rated value
A.C. VOLTAGE
150/300/600 V
Accuracy ± 3% of rated value
RESISTANCE (OHMS)
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Accuracy ± 3% of scale length.
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ACCESSORIES INCLUDED
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3206 DIGITAL CLAMP TESTER A "Field Effect" type liquid crystal display ensures good contrast for low power consumption–approx. 100 hours continuous use with alkaline batteries. Features include auto range selection, peak hold and display hold facilities.

READING RANGE
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0-20 amp range, 200 and 1000 amps max.
A.C. VOLTAGE
0-1000 volts.
RESISTANCE (OHMS) 0-2000Ω
DIMENSIONS (Approx)
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ACCESSORIES INCLUDED
Carry case, test leads, spare fuse, alligator clip.

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the PET computer

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SPECIAL AT NO EXTRA COST

$200 value of programmes will be provided with each PET purchased prior to December, 31st, 1979.

2001-16/32

The CBM Computer is now a truly sophisticated Business System with the announcement of these Peripherals.

The CBM incorporated with the Floppy Disk and Printer makes an ideal business system for most professional and specialized fields, medicine, law, dental, research, engineering, toolmaking, printing, education, energy conseration etc . . . The CBM Business System as a management tool, delivers information to all levels of Business previously attainable only with equipment many times more expensive, the CBM Business system is one of the most cost efficient business tools today. It offers a wide range of applications from logging management strategy in major corporations to organizing accounts and inventory control of small businesses. Here are just a few of the cost saving uses in the corporation, professional office or small business stock control, purchasing, forecasting, manufacturing, costing, customer records, mailing list, etc. The CBM Floopy Disk and Printer, a compatible business system at a reasonable price — Take a closer look at these Peripherals.

2040

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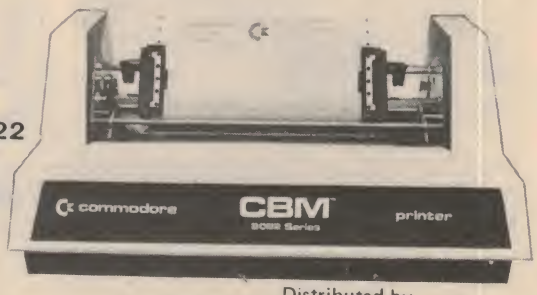
Tractor Feed Printer

2022



The Tractor Feed Printer is a high specification printer that can print onto paper (multiple copies) all the CBM characters — letters (upper and lower case), numbers and graphics available in the CBM The tractor feed capability has the advantage of accepting mailing labels, using standard preprinted forms (customized), cheque printing for salaries, payables, etc. Again, the only connections required are an A/C cord and CBM connecting cord. The CBM is programmable, allowing the printer to format print for: width, decimal position, leading and trailing zero's, left margin justified, lines per page, etc. It accepts 8½" paper giving up to four copies. Bidirectional printing enables increased speed of printing.

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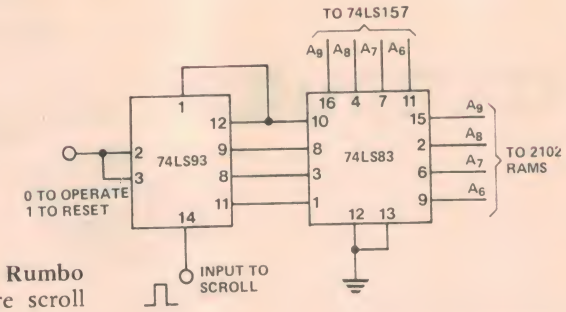
Collected tech tips for computer buffs

Hardware Scroll For ETI640



A cunning circuit from E. R. Rumbo of Weetangera adds a hardware scroll facility to the ETI 640 VDU.

Scroll occurs when the cursor (the point on the screen at which the computer is writing) reaches the end of a line. All the lines on the screen then have to move up to make room for a new blank line at the bottom. Usually, this is done by the processor laboriously moving all the characters on the screen up one line. This is rather slow and an alternative is the circuit shown.

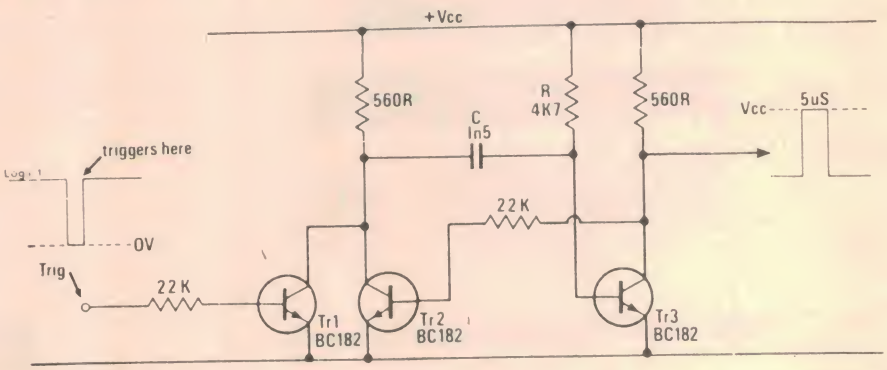
The 74LS83, a 4-bit adder, is used to offset the address of the memories whenever the rest of the circuit calls for a particular character. That character will then 'appear' a number of lines further up the screen. The position of the characters is controlled by the 74LS93 4-bit counter, which will scroll the entire screen contents up one line every time an input pulse is received from the processor.

This configuration will not produce a blank line at the bottom of the screen, however. This will still have to be done by software as, with this circuit, the top line of the display appears at the bottom when the screen is scrolled.

Rising edge trigger

The diagram shows a method of triggering a conventional monostable on the rising edge of a short negative-going pulse. The additional transistor, TR1, provides good isolation between the output pulse and the triggering circuitry. The circuit shown gives a pulse of 5μsec duration, but of course the usual design formula $\tau = 0.65$ RC can be used to determine circuit values for other pulse widths.

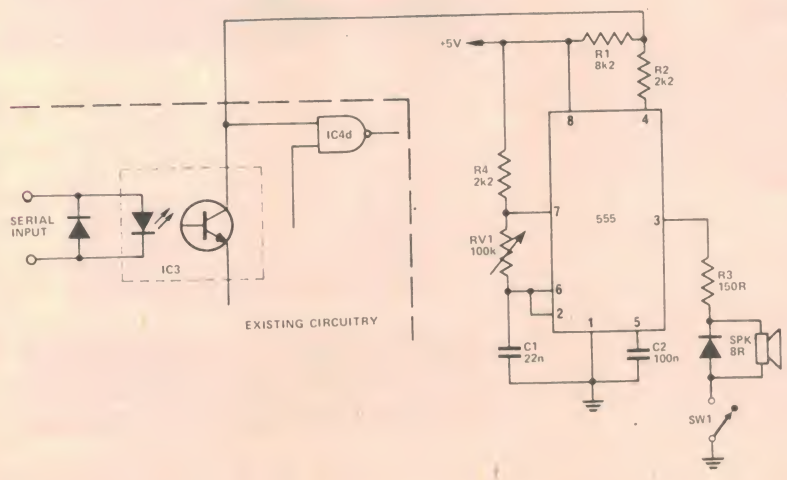
One slight disadvantage of this circuit is that the collector of TR2 is held down by the triggering wave-form, so the switch-on of TR3 is not regenerative. For this reason the falling edge of the output pulse is not as fast as it might be, but is sufficient for most purposes.



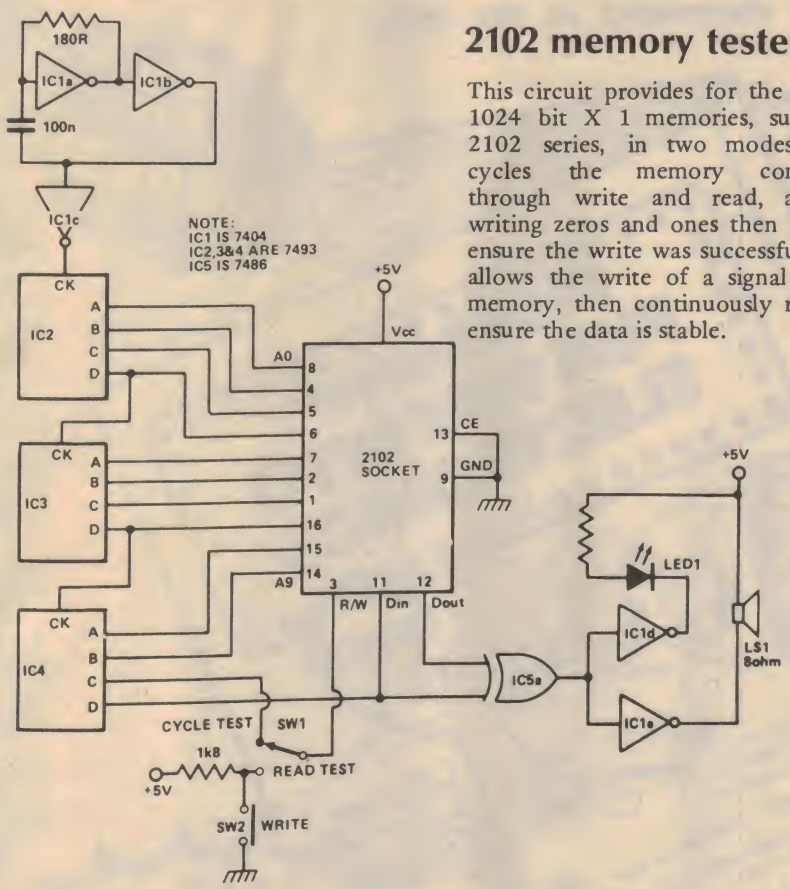
Bleeper for VDU

When using the ETI 630/631/632 VDU, one problem a reader came across was its totally silent operation! Being used to a teletype (which is far from silent), he found that when entering lists of numbers it was necessary for him to keep looking at the screen for the processor's 'prompts'. To alleviate this problem, the following circuit modification will produce audible 'bleeps' whenever characters are received from the processor.

The operation of the circuit is fairly straightforward, the reset pin of the 555 being used to gate its oscillation. RV1 sets the frequency (which is largely a matter of personal preference) and the switch allows the bleeper to be switched off when dumping onto tape.



2102 memory tester

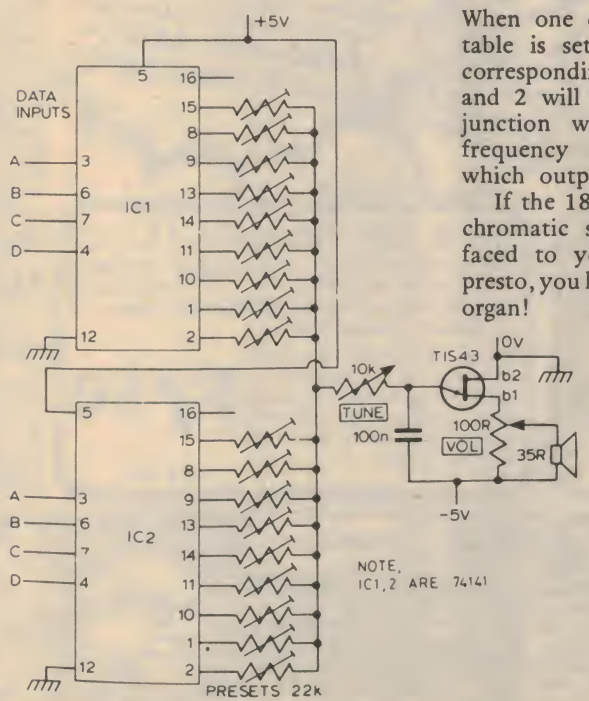


This circuit provides for the testing of 1024 bit X 1 memories, such as the 2102 series, in two modes. Mode-1 cycles the memory continuously through write and read, alternately writing zeros and ones then reading to ensure the write was successful. Mode-2 allows the write of a signal onto the memory, then continuously reads it to ensure the data is stable.

In both modes, the output from the memory is compared with what should be there, and if there is a difference, an LED flashes, accompanied by a click from the speaker. In Mode-2, on power on, a continuous noise will be heard from the speaker; on pressing the 'WRITE' button this should vanish. Similarly, a brief pulse of noise will be heard in Mode-1 before the write is completed. The oscillator frequency is about 20 kHz with components shown.

In Mode-2, when the supply voltage drops below 4.5V, memory is not stable for more than a fraction of a second, although this does not show up using Mode-1.

BCD tone generator

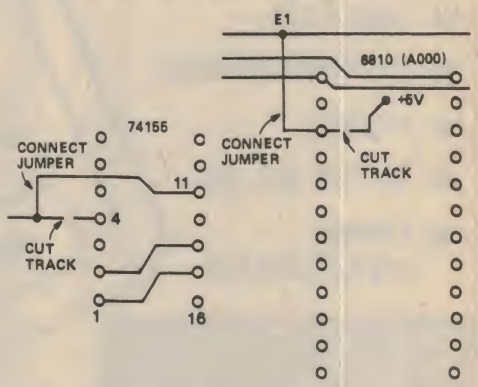


When one of the binary codes in the table is set up on the data inputs, a corresponding preset connected to IC1 and 2 will be grounded, and the uni-junction will start to oscillate. The frequency of oscillation depends on which output of the ICs is grounded.

If the 18 presets are tuned to form a chromatic scale and the inputs interfaced to your MPU data bus – hey presto, you have a simple MPU controlled organ!

NOTE No	CODE (BINARY) HGFE	DCBA
1	0000	0001
2	0000	0010
3	0000	0011
4	0000	0100
5	0000	0101
6	0000	0110
7	0000	0111
8	0000	1000
9	0000	1001
10	0001	0000
11	0010	0000
12	0011	0000
13	0100	0000
14	0101	0000
15	0110	0000
16	0111	0000
17	1000	0000
18	1001	0000

D2 Kit Modification



When using the Motorola D2 kit with external RAM located at 0000, the 512 bytes of RAM supplied with the kit is 'overlayed' by the external chips. This means that the user has 'lost' his 512 bytes.

Allen Bruce of Millfield thought that this was a bit of waste (excuse the pun – Ed) and decided to do something about it. He has effectively moved the on-board RAM so that is starts at A000, allowing the use of all the RAM in the system.

The modifications are as follows:

Cut the track from the MC74155 at pin 4. This is the 'not RAM' signal going to the four RAM sockets. Connect a piece of wire between pin 11 of the 74155 and the track going away to the four RAM sockets.

Pin 10 of A000 RAM is connected to +5V. Cut this track and take pin 10 to address line 9. The best place to connect this is at the place where "E1" is marked on the top side of the board.

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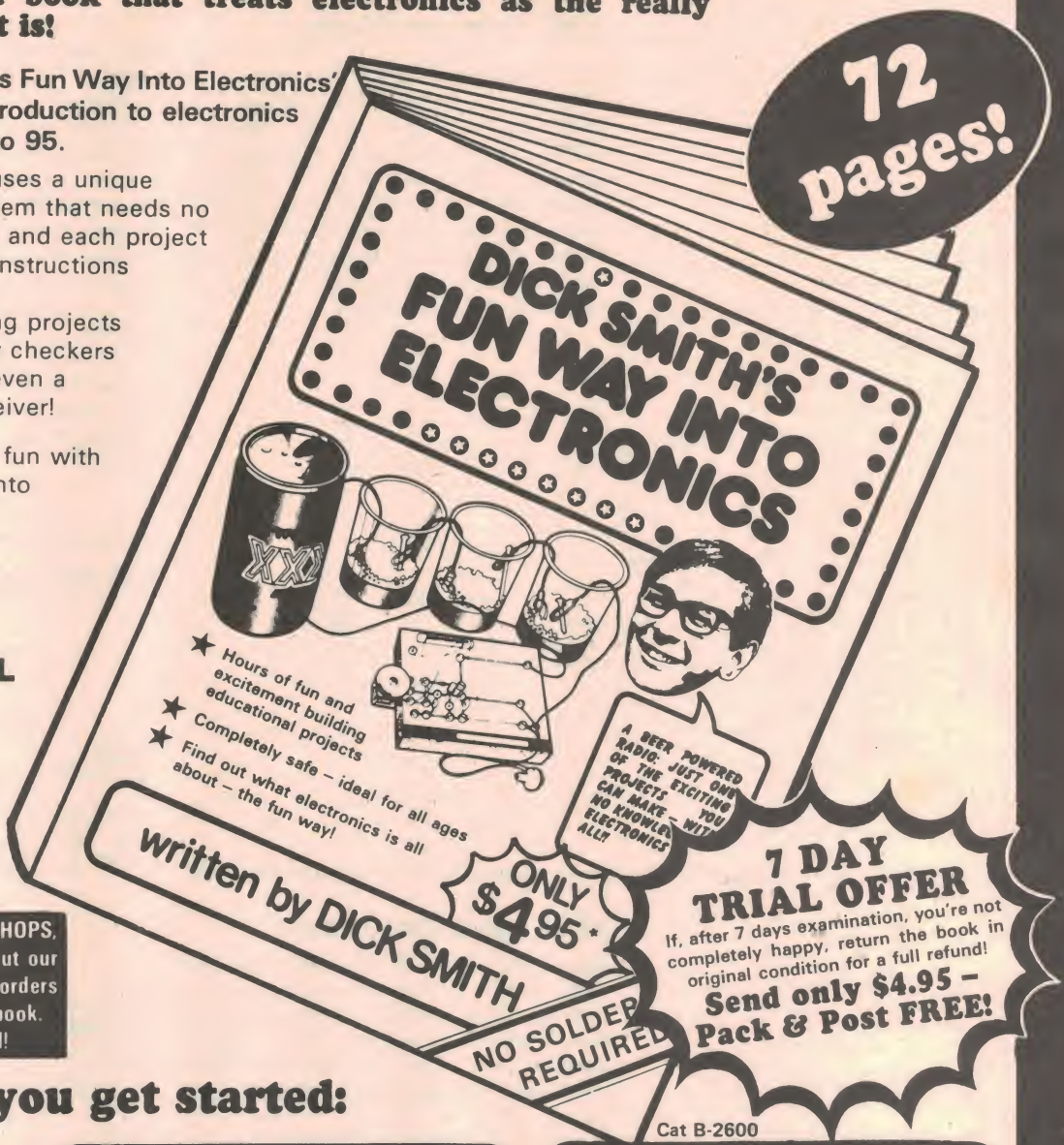

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Build the first ten projects with these components – even includes the baseboard to assemble them on. You can make light flashers. Morse communicators, transistor checkers, continuity indicators, etc etc.

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KIT 2: FOR PROJECTS 11 – 20

This kit contains slightly more specialised components which, with the components in kit 1, will enable you to make the last ten projects, including radio receivers & transmitters, audio amplifiers, etc.

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Cat K-2610

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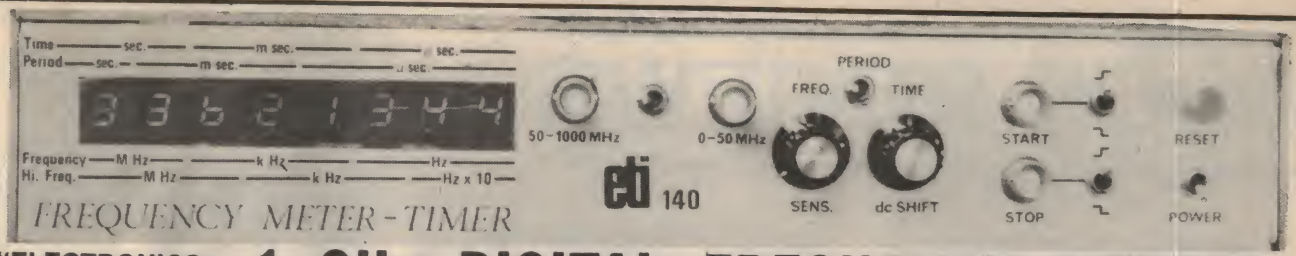

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High frequency input	20mV
Time inputs	0V to +3V level shift
Input impedance	
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High frequency input	≈ 75 ohms
Time input	>10k
Maximum input voltages	
Normal input	70V ac,∓ 100V dc
High frequency input	200mV ac,∓ 50V dc
Timing inputs	∓100V dc
Crystal frequency	
nominal	4000kHz
actual	3999.996kHz
Stability and accuracy	
Frequency	Depends on crystal used and initial adjustment. Oven used keeps temperature within 2° C.
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The upper limit of the prescaler has not been checked due to the lack of a signal source but both the preamplifier (OM335) and the divider ICs are specified up to 1GHz.

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BOOK REVIEWS

Dick Smith's Fun Way into Electronics, written and published by Dick Smith, edited by Sam Voron and Ross Tester, illustrated by Mike Middleton.

Review copy from the publisher. $4.95.

THIS BOOK does exactly what it says — shows a fun way into electronics for the raw beginner. And it does it *right*. The choice of circuits, the illustrations and (generally) the text are aimed smack dab at the new chum electronics enthusiast. No doubt everybody who has ever had anything to do with electronics retailing or publishing has had ideas of producing a book of this sort. But, when faced with the reality of *exactly* how to do it, what level to write at and how to present *real* projects, many have baulked at the enormity of it all. The production of a book of this sort is no easy task. There are literally thousands of small details that have to be seen to, or the whole project founders. Construction details and diagrams have to realistically relate to the components specified or a person unfamiliar with the 'bits' of electronics, as every newcomer is, will rapidly become confused, then angry ... eventually abandoning electronics as "too complicated".

This book fulfils all the requirements. Its large format, 212 mm by 272 mm, pages, clear diagrams and illustrations and use of spot colour (orange), together with clear typesetting, make it a delight to use. The writer's not-yet-six-year-old son was delighted when he first viewed the book, and had little difficulty recognising the components and following the diagrams and instructions (he reads his *own* bedtime stories!). His elder brother (nine) however, commandeered the book so he could try some of the later circuits, eschewing the continuity indicator, transistor tester and suchlike as 'kid stuff'. As we only received one book for review, they'll have to share it.

There are twenty projects, ranging from the aforementioned continuity indicator through a flasher, morse code set, crystal set, simple radios, various transistor amplifiers and some simple 'demonstration' transmitter circuits (they work, but very short distance). There's even a beer-powered radio! (A nickel-iron battery using beer as the electrolyte).

The projects are designed to be constructed on small rectangles of chip board. In the back of the book are twenty cutout layout diagrams. These are stuck to a piece of chip board and connection points for the components are made by screwing small screws through the overlay into the board at the points indicated. Very cunning. Simple too. The interconnections are all indicated on the overlay, so the chance of doing something incorrectly is vanishingly small. This is one of the best ideas we've seen in a long time. The diagrams with each project refer directly to the method of construction. All projects are battery operated and protection diodes (against reverse polarity) are included.

Several pages in the rear of the book are devoted to a discussion on how radio works and two further pages gives terms used and their definitions.

Pictorial illustrations of all the components used, together with their circuit symbols, are given in the front of the book, along with resistor and capacitor marking codes and metric units.

While the text is not 'rigorous' in the technicalities, it should be generally adequate for the newcomer. It shows some signs of hasty editing but such shortcomings as do exist should disappear in the next edition.

Full kits for project 1-10 are available for $6.90 and for projects 11-20 for $7.50. The book costs $4.95. That's good value.

For the newcomer — spot on!

Roger Harrison

Beginning BASIC, Paul M. Chirlian, dilithium Press, 1978.

Review copy supplied by Computerland Australia, 55 Clarence Street, Sydney 2000. $11.65

ALTHOUGH not specifically written for microcomputer users, this is a very good introduction to the BASIC computer language. Starting with an introduction to running programs on timeshared and batch systems, which most users could virtually skip, the book is meat from there on.

The only problem is that it doesn't mention which dialect of BASIC it uses, and it introduces such curiosities as the SETDIGITS statement without explaining that such statements are not available on most BASIC interpreters.

The book is organized logically, starting with arithmetic and progressing through I/O statements, control statements, looping, arrays, subroutines, strings, debugging, vector and matrix operations, data files and then four appendices of quick reference information. Obviously, to compress a considerable amount of information into a book like this, the author has had to adopt a fairly dry style, but since most readers will be strongly motivated by the desire to start programming, this is not very important.

Overall, a handy reference for the novice programmer.

Les Bell

Understanding Computers, Paul M. Chirlian, dilithium Press, Portland, Oregon, 1978.

Review copy supplied by Computerland Australia, 55 Clarence Street, Sydney 2000. $11.35

THERE IS a great gap in the available literature for the personal computing tyro; although this book is doubtless an attempt to fill it, it is an unsuccessful attempt. The book talks at length about the kind of hardware which simply does not exist these days, especially in microcomputers — magnetic core memories, for example, just do not rate four pages of discussion in any up-to-date volume.

The contents really cover the basics of digital logic circuitry in a building block fashion, but unfortunately no examples of real devices, from either the TTL or CMOS logic families, are given. This is a great pity, as it conveys the impression that the author has little experience of the real world of microcomputing.

Again, the novice to computing is scarcely likely to have to count in binary or know much about floating point representation of real numbers

— he can generally view the computer as a sophisticated calculator in this area.

The last section of the book discusses system software, high level languages, etc. at a more realistic level, and there is some good meat in this part. However, as a large London department store has said on occasion, 'Miss Selfridge regrets . . .'.

Les Bell

NCR Data Communications Concepts, NCR Technical Education Department, E&L Instruments, Inc, Connecticut, 1978.

Review copy supplied by Stewart Electronics, 33 Sunhill Road, Mt Waverley, 3149. $8.00

THIS IS A FAIRLY GOOD introduction to data communications concepts for computer people without an electronics background. Starting with general telephone circuitry, it progresses through a discussion of basic transmission line theory, time division multiplexing and some of the other buzzwords that fall within the domain of the data communications engineer.

Readers with a general electronics background will already be familiar with many of the concepts covered in the book, but it may serve as a useful refresher course. For computer hobbyists and those with a computing background, it will serve as an excellent introduction to a field of increasing significance.

Les Bell

CMOS Designer's Primer and Handbook, Robert M Glorioso and Jack Streater, E&L Instruments Inc, Connecticut, 1978.

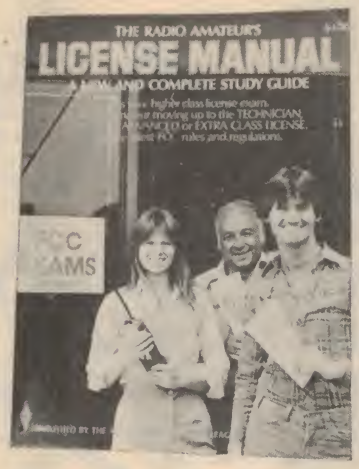
Review copy supplied by Stewart Electronics (see above). $10.00

ANOTHER of E&L Instruments' excellent series of practical handbooks which grew out of the "Bugbook" series. This book deals with CMOS — not just the common and garden 4000 series of CMOS logic gates that just about every ETI project seems to use, but also linear devices such as the TL-080 series of CMOS op-amps from Texas Instruments as well as CMOS microprocessors — the RCA CDP 1802 and the Intersil IM6100.

The treatment is both tutorial and experimental, and all the circuits given in the book have sufficient information to enable the reader to build the circuit and try it. Again, the experiments are well-organized, with tables to be filled in and questions to be answered.

Two large appendices give a glossary (as well as an index) and a CMOS minicatalog of abbreviated data sheets. The book is well organized to serve both as a tutorial text and as a reference book for the bookshelf above the workbench. Where (if you use CMOS) I would suggest you put it.

Les Bell



The Radio Amateur's License Manual, published by the ARRL. 1979.

Review copy supplied by the publishers, available through various bookstores and suppliers, about $6.00

ALTHOUGH specifically written around the requirements of the American amateur licensing system, this book contains a wealth of good, basic technical information covering the elements of electricity and electronics with special emphasis on communications as it pertains to amateur radio.

The text is written in the usual clear, easily-read style so familiar from many ARRL publications. Sample questions are provided with each section, with answers at the rear of the book, so that one can advance stage by stage, checking progress on the way.

The diagrams are clear and well set out.

The only sections of little use, but perhaps of passing interest, are those on the US amateur regulations. A section on International regulations is interesting but not examined by the Australian authorities.

The large format, 210 mm by 270 mm, makes for easy reading. The book is 'square-backed' and has a stiff card cover. It would be a valuable basic reference to the fledgling amateur — a few 'old timers' might find it instructive also! ●

Roger Harrison

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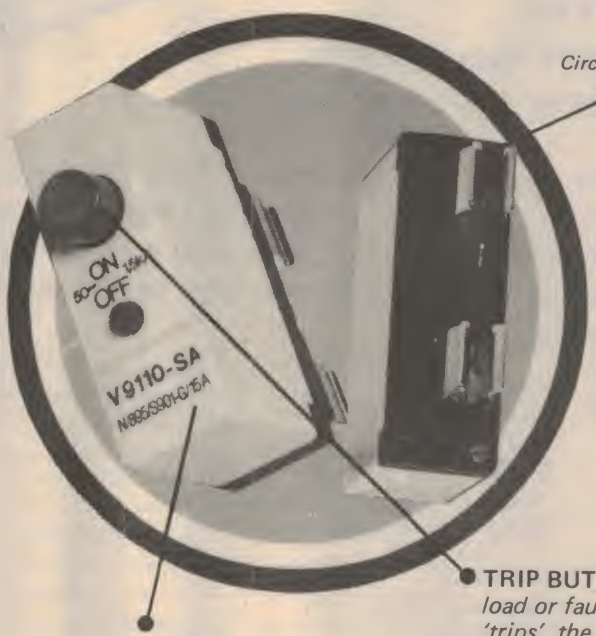

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LETTERS

Dear Sir

I note your "Lab Notes" in October ETI concerning the LM 723-derived Power Supply. Over the years since its publication in Nov 1972, I have seen it copied (and as I am about to say, I do mean copied) into circuits in other magazines and numerous club journals. I soon built not one, but two power supplies using the circuit, with and without modifications, and so did many of my friends. For all who built it as well as myself, the circuit performed terribly. How? Most people "blew" at least one IC, and after the second, threw the thing away, probably replacing it with discrete components. Current limit resistors, even 2N3055s and power diodes went west. I must confess - I have three dead 723s. Even if one was careful enough to preserve the power supply by never shorting it out, regulation was poor - sudden disconnection of a load would cause a one volt positive spike at the output, visible on a voltmeter. And it hummed!

I have since been amazed at the design notes in many articles, referring to a device with specs of ripple rejection at 50 Hz, of 74 dB with no output capacitor or Vref capacitor (the latter I always incorporated into the design). I seem to recall your magazine's original article as stating that a 50μF capacitor had to be added to the output to hold down hum. (Note: suggested value for 7812 = nil to 50 nF).

My sincere apologies for not writing this six years earlier when I realised the designed-in fault. I have until now assumed that some obscure errata column carried the answer, but realise from the current article that this must not be so.

Now I have met some people who have made, as in the present article, many of these units, usually for someone else's use, and report only occasional "by the way" failures - usually a "burn up" involving IC, power transistor and especially Rsc in the circuit as shown; or no trouble at all. I should point out that the applications referred to in the article are quite non-critical of regulation, and that the original circuit will withstand short-circuits 90% of the time, and indefinitely if not occuring rapidly.

So what is the fault?

Very simple. The compensation capacitor is specified at 1000 times the correct value! i.e.: 100 nf instead of 100 pf. All the other designs have slavishly followed this value, even though they may have changed its configuration.. Assuming shunt configuration - i.e.: C comp from Pin 13 (DIL) to earth, this sets the slew rate at about 7.5 V/ms. In feedback configuration i.e: C comp between Pins 13 and 4 (DIL) this figure becomes so much worse - thus the failure of ac regulation. As a second consequence, the current limit transistor on the IC is obliged to "pull down" this capacity in the event of an instantaneous short circuit (the most common sort) while the full output voltage appears across its base-emitter junction. From experience, it rapidly tires of this, suffering lead burnout (within the package) and either emitter or base "goes open". Not surprisingly, an external, discrete transistor substituted in the position fares likewise soon after. Without current limit action the resistor soon burns, unless it is rugged, in which case it passes the load to the 2N3055, power diodes and transformer, whichever is weakest. This immediately precedes user dissatisfaction.

The cure is obvious - use a 100 pf capacitor. Although the manual shows values ranging from 100 pf to 500 pf (depending on pass transistor gain) in feedback configuration and 1 nf in shunt configuration (5 nf in a shunt regulator - which uses higher gain of the loop). I have used lower values with complete success in a tightly-designed pc board. Regulation is now excellent, and the 50μF output capacitor may be dispensed with, in favour of about a 1μF (to pass frequencies above about 10 kHz). The 5μF bypass on the wiper of the pot now is functional, adding the "cream on the cake".

Now far less stressed, the current limit transistor performs without complaint, and on a 50 mA or so limit, and with little output capacitance, the supply can be shorted across an emitter-base junction without damage.

Just in case, a resistor of at least 100 Ω can be inserted in the "current limit" line - Pin 2 (DIL) and this could easily be added to your ETI 111 board.

A further warning about switching of the feedback resistors R2 and R3 in your circuit. It is possible to produce, for example 7V and 15V ranges switchable, but this must be done by opening R2, never by shorting R3 as this can put a 15V transient on the comparator, again resulting in instant destruction due to the output capacitance.

Hoping you make some use of this.

Paul B Webster
Earlwood, NSW

Dear Sir

I am writing to you in the hope you can give me some further information on an article in October's ETI.

We collect quite a lot of gem stones in our area and occasionally an aquamarine "Beryl".

In the October issue, there is an article "Beryllium, how dangerous?"

Could you find out for me if the Beryl we collect and cut and polish is the same Beryllium as in the article?

I enjoy reading your magazine,

Ray Taylor
Innisfail, Qld

Beryllium is found in nature in two forms; known as Beryl and Chrysoberyl, they have chemical compositions as follows:

Beryl: $Be_3Al_2(SiO_3)_6$

An ore of Beryllium, translucent to light green in colour (aquamarine). It is a metal, prized as a gemstone.

Chrysoberyl: $BeO.Al_2O_3$

It contains Beryllium Oxide with an oxide of Aluminium in the crystal structure. It is potentially carcinogenic. Alexandrite is another form - dark green in colour, red in transmitted light. Chrystoberyl is green in colour, possibly due to Chromium present in trace amounts. It is very hard (8.5).

I trust this answers your question.

Roger Harrison

Dear Sir

In recent New Scientist magazine (12 July, p.129) it was claimed that liquid crystal displays only have a life span of five years. In view of the widespread use of these devices in watches, calculators, etc., it would be interesting to know if this claim is true and if so why the secret has been so well kept.

J A Fisher
Lake Albert, NSW

It's not that well kept a secret. See ETI December 1975, page 90.

sound

FEATURES:

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JACKA 1711

Audio Reflex' "Lab 80" system

Latest top-of-the-range system from Audio Reflex is their 'Lab 80', featuring five top-line components in a cabinet plus a pair of floor-model speakers.

In keeping with modern design trends, the units are housed in a high quality walnut finish vertical cabinet with tinted glass doors and four shelves providing ample storage for cassettes and records.

The floor standing speakers, model SB485, have a handling capacity of 100 watts RMS with a 380 mm (15") bass driver for optimum bass response.

The amplifier delivers 80 watts RMS per channel according to the Audio Reflex literature.

The front-loading cassette deck has a Dolby noise reduction system, soft eject, separate bias and equalisation for normal FeCr and Cr02 tapes and memory.

The tuner offers high signal to noise ratio with low distortion and high AM/FM sensitivity. It has a free-flowing flywheel tuning wheel, as well as LED meter for optimum reception, LED signal meter, tuning meter for optimum FM reception, and multiplex filter.

The semi-automatic direct-drive turntable comes complete with woodgrain base, lid and magnetic cartridge. Other features include damped cueing, anti-skate and auto return.

An optional extra is the model EQ1 graphic equaliser.

The LAB80 system has a recommended retail price of $1699. Further details are available from Audio Reflex (Australia) Pty Ltd, 7 Orchard Rd, Brookvale NSW 2100, (02) 938-4188.

Modular sound measuring instruments

Norwegian Electronics A.S. manufacture a series of modular-designed instruments that can be combined to suit a wide range of applications.

The basic instrument in the range is the Sound Meter type 108 which may be used to measure sound pressure level, equivalent continuous sound level (Leq.) or perform a distribution analysis.

A bandpass filter, type 719, may be added for frequency analysis and noise excitation measurement applications.

A further module, type 210, a reverberation calculator, can be used to determine reverberation times from 150 ms to 20 seconds. For noise excitation of rooms, a loudspeaker unit with built-in power amplifier, type 811L is available and for impact sounds, the tapping machine type 211 generates impulse noise in accordance with ISO 140 requirements.

Further details may be obtained from the Dindima Group Pty Ltd, P.O. Box 106, Vermont, Vic 3133.

Audio 2000 get Grado

Sydney-based importer / distributor Audio 2000 were recently appointed sole Australian distributor for Grado Laboratories of the USA.

Grado cartridges have earned an enviable reputation overseas for their outstanding performance at very reasonable prices. The full range of Grado cartridges is available from Audio 2000 — except for the 'Signature Series' which initially will only be available to special order.

The majority of Grado cartridges have been designed for use in either lower priced turntable systems or the most advanced turntable and tone arm combinations. Another feature of the Grado range is their ability to be used with a wide variety of tone arm types. Prices start from as low as $18 ranging up to $250.

Grado cartridges feature the unique patented 'flux bridger' construction which allows for improved tracking through a lower tip mass.

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From Audio 2000, P.O. Box 107 Brookvale NSW 2100. (02) 939-2159.

Fosgate—spectacular car sound equipment

American car sound equipment manufacturer, Fosgate, recently appointed Sydney-based importer Communications Power Inc. (CPI) as Australian distributors, who have released the updated Fosgate power amps to the local market.

Traditionally, car sound has not been considered as being within the ambit of 'hi-fi' equipment, but recent developments have made true hi-fi in the car a reality and not a pipe dream.

Fosgate are one of the leaders in this area in the American market, which is currently enjoying quite a boom. They offer a range of 20 W, 100 W and 200 W (RMS!) solid-state amplifiers and matching preamp/control units.

The 20 W unit, model PR-220 Type II, is an integrated unit rated at 20 W RMS per channel across 20 Hz to 20 kHz at less than 0.05% THD. Fosgate quote the slew rate as 60 V/us, ensuring good TIM and SID performance. Noise is quoted as -80 dB from full power output and sensitivity as 3.5 V RMS.

Model PR-250 TYPE II is a straight power amp rated at 100 W RMS (50 W per channel) into 4 ohms with a bandwidth of 20 Hz to 20 kHz and THD of 0.05%. Again, slew rate is given as 60 V/us and noise as -80 dB on full output. Sensitivity is quoted as 0.5 V RMS and this little mother pulls 18.5 amps at full output from a 14.5 Vdc supply.

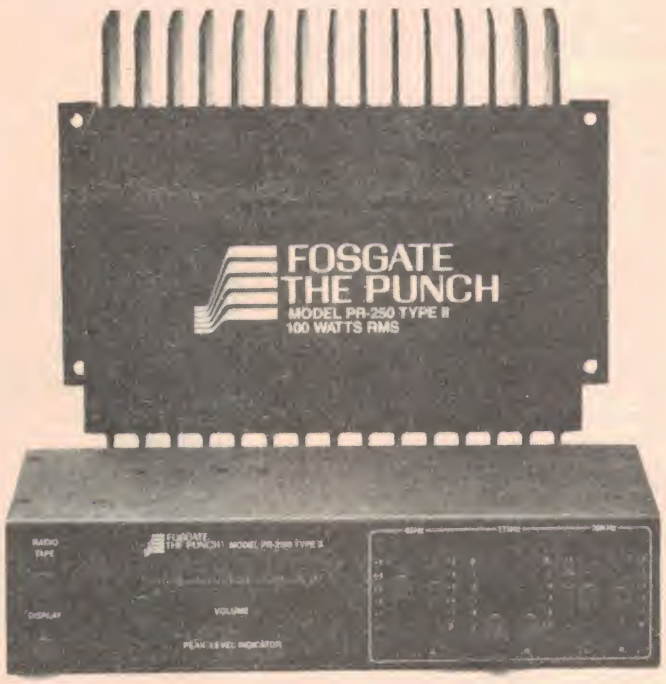
The big mother is model PR-2100 Type II. Fosgate say this will deliver 200 W RMS into 4 ohms — from the specification sheet, it seems they split each channel into a high and low band. Frequency response is quoted as 20 Hz to 20 kHz, THD as 0.05% and slew rate as the usual 60 V/us. Sensitivity is given as 0.5 V RMS for full output and she'll suck 37 amps from the 14.5 Vdc supply at full output, according to Fosgate. We'd recommend you not turn the volume up while your engine is idling!

Fosgate's 'standard' preamp is the model PR-250 Type II which has straightforward volume, bass and treble controls. Frequency response is quoted as 20 Hz to 20 kHz plus/minus 0.25 dB and THD as 0.05% at 5 V RMS output. Fosgate specify the noise as -90 dB from full level and the slew rate as 60 V/us. Gain is given as 20 dB, bass boost as 18 dB max at 45 Hz, treble boost as 12 dB max at 20 kHz.

Their top-line control unit is the model PR-2100 Type II. This is an integrated preamp-equalizer having a frequency response from 20 Hz to 20 kHz, flat within plus/minus 0.25 dB, less than 0.02% THD at 5 V RMS output and 60 V/us slew rate, according to Fosgate. Noise is quoted as -90 dB on full output. The equalizer is a three frequency unit providing 18 dB max boost per channel at 45 Hz, 8 dB max cut per channel at 175 Hz and 12 dB max boost per channel at 20 kHz. Presumably this is tailored to the acoustic inadequacies peculiar to cars.

All the power amplifiers feature "Short Stop computer logic" protection against shorts and overloads, plus pulse-width modulated (PWM) power supplies.

Further information can be obtained from CPI (Australia) Pty Ltd, P.O. Box 246, Double Bay NSW 2028. (02) 36-3703, TLX AA23381.



New cassette deck from Hitachi

Hitachi's recently released D-5500 cassette deck features a microcomputer control system, a 'unitorque' motor said to eliminate cogging, independant reel and capstan motors and an "automatic tape response system" (ATRS) that adjusts bias and equalization, automatically, for the tape in use.

The ATRS system permits a simple setting up procedure when doing a recording: the cassette is simply loaded, the deck set for record and the 'test' button pushed. The machine will then perform all the required adjustments.

Another feature incorporated in the D-5500 is a standby random access memory (RAM) that will store all current operations in the event of a power failure.

The D-5500 also provides a memory for the results of test runs on three different tapes. By placing the bias and equalization setting of the three tapes you most frequently use in memory, each can be instantly recalled at the touch of a button.

Manual operation of the deck is also provided. Dolby noise reduction is included as standard.

The record/playback system employs three heads, the record and playback head being Hitachi's new "closed gap" single unit type. Hitachi claim this closed gap configuration achieves optimum tape-to-head contact, reduces level fluctuation and improves overall quality. The head surface is finished by a special titanium bonding process, permitting smooth tape travel and reducing dust adherence, say Hitachi.

An infrared remote control unit is available which can also double as an on-deck control panel.

More information from Hitachi Sales Aust. P/L, 153 Keys Rd, Moorabbin Vic 3189.

TDK/Toyoda/Convoy joint venture

TDK, Tokyo based manufacturers of tapes, cassettes, ferrites and other specialised components for the electronics industry, have now entered the Australian market directly, with a new company, TDK (Australia) Pty Ltd.

Backing TDK in this move are Toyoda Tsusho Kaisha of Nagoya (associates of Toyota), and Convoy International, the companies who first established TDK on the Australian market in 1970.

Changes brought about by this joint venture have resulted in the following appointments: Mr Malcolm Goldfinch remains chairman of Convoy International and relinquishes the role of Managing Director. He becomes Chairman of Directors of TDK (Australia) and is one of the joint venture partners.

Akio Akakura, formerly of TDK Tokyo, is now Managing Director of the Australian company.

The new Managing Director and 50% shareholder of Convoy is Mr Alex McInnes, formerly of Lanray Industries.

Mr Geoff Matthews of Convoy becomes Manager of Nakamichi and B&W Hi-Fi Products, while the Convoy Electrosonic Audio Visual products and convention centre are now managed by Mr Peter Warrall.

Toshiba expands micro hi-fi

Following introduction of the top-of-the-line 15 series components earlier this year, Toshiba recently announced the addition of two less sophisticated systems — the 30 W 12 series and the 20 W 10 series.

Both systems supplement the 15 series and the complete line up will be available during November/December.

The ten individual micro components give Toshiba the most comprehensive range on the Australian market according to the company's release.

The System 12 comprises a stereo power amplifier (SC-M12); stereo preamp (SY-C12); FM/AM tuner (ST-10); and metal tape stereo cassette deck, PC-D10.

The System 10 comprises an integrated stereo amplifier (SB-A10); FM/AM tuner (T10) and the PC-D10 stereo cassette deck.

More details from Toshiba (Australia) Pty Ltd, 16 Mars Rd, Lane Cove NSW 2066.

Five new Pioneer systems

Pioneer have released five new hi-fi systems, two under the Formula name, and three Avantes.

These are: the Formula 4000, a four-piece receiver system ($499); Formula 6000, a six-piece tuner/amp system ($699); and the Avante models 33, 55 and 77, all six-piece tuner/amps ($759, $999 and $1199 respectively).

With the exception of the Formula 4000, each system includes a matching cabinet, the Avante models also having glass doors. The Avante models 33,55 and 77 have slim-line direct-drive turntables with ultra-thin motor and coaxial suspension for reduced size. All components in these systems conform to a standard 420 mm width measurement.

There is a choice of 45 W, 25 W or 20 W continuous per channel, and two-way or three-way models. All have FM tuners, and two include Fluroscan output meter displays.

The Formula 6000 closely resembles the Avante 33, but has a belt-drive turntable and a different cabinet, while the Formula 4000 is a powerful 16 W receiver system.

Matching cassette decks are available for coupling to all the above systems; Pioneer recommend the CT-506 deck for the Formulas, CT-F600 with Avante 55 and 33, and the CT-F650 metal deck for the Avante 77.

Pioneer have also announced a three-year warranty period, effective as from late October, on their entire range of hi-fi products.

This extends the previous warranty period for turntables and cassette decks from 12 months to three years, hi-fi components increase from two years to gain parity with the company's speaker range which retains a three-year warranty.

Car sound and portable audio products have also had their six-month warranty period extended to twelve months.

Philips woofers

To meet the international market demand for round frame loudspeakers, Philips have introduced a new range of 203 mm (8") woofers, intended for use in sealed acoustic enclosure systems with a maximum volume of 25 litres. They are available with 4 ohm and 8 ohm impedances.

The AD80601/W and AD80602/W have a resonance frequency quoted as 42 Hz and a frequency range of 50 Hz to 4 kHz, according to Philips. The former has a rubber surround, and the latter a polyester surround. Power handling capacity is rated at 50 W without filter, maximum crossover frequency 2 kHz, maximum power on the loudspeaker 100 W, operating power is 5 W.

Models AD80651/W and AD80652/W have a resonance frequency of 39 Hz, a frequency range of 50 Hz to 5 kHz, power handling capacity of 50 W, maximum crossover frequency 2.5 kHz, and maximum power on the loudspeaker of 100 W according to the Philips data. Operating power is 3.8 W. The AD80651/W has a rubber surround, and the AD80652/W has a polyester surround.

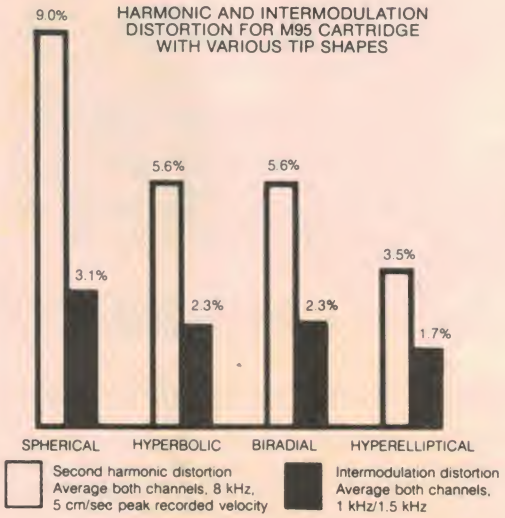
The last two models, AD80671/W (rubber surround) and AD80672/W (polyester), have a power handling capacity of 60 W, operating power 9 W, maximum recommended crossover frequency 3 kHz and maximum loudspeaker power of 120 W, say Philips.

All are distributed by Philips Electronic Components and Materials Division, P.O. Box 50, Lane Cove NSW 2066.

fact: dramatic freedom from distortion comes to a mid-priced cartridge: the new Shure M95HE...

an affordable, audible improvement

One of the critically acclaimed advances introduced in Shure's incomparable V15 Type IV pickup is its revolutionary and unique distortion-reducing Hyperelliptical stylus. Now, you can enjoy this standard of sound purity in a new, ultra-flat frequency response, light tracking, high trackability cartridge that will not tax your budget: the new Shure Model M95HE.

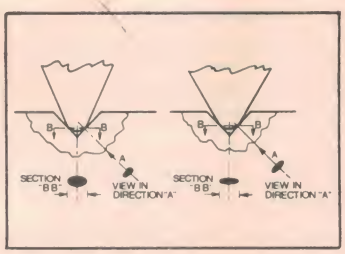


a measurable drop in distortion

As a result of the optimized contact area of the Hyperelliptical tip, both harmonic distortion (white bars in graph above) and intermodulation distortion (black bars) are dramatically reduced.

the Hyperelliptical stylus tip

BIRADIAL (ELLIPTICAL) STYLUS SUCH AS IN M95ED



HYPERELLIPTICAL STYLUS OF THE M95HE

The Hyperelliptical nude diamond tip configuration represents a significant advance in tip design for stereo sound reproduction. As the figures show, its "footprint" (represented by black oval) is longer and narrower than the traditional Biradial (Elliptical) tip-groove contact area. Because the Hyperelliptical footprint geometry is narrower than both the Biradial and long-contact shapes such as the Hyperbolic, it is pre-eminent for reproduction of the stereo-cut groove.

upgrade your present M95 If you already have a Shure M95 Series Cartridge, you can improve its freedom from distortion right up to the standards of the new M95HE cartridge simply by equipping it with a Model *N95HE* stylus. The cost is extraordinarily low — yet the difference in sound will be immediately apparent. Takes only seconds to install — requires no tools whatsoever.

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sound news

Slimline portable cassette recorder

The National Panasonic Slimline cassette recorder, model RQ 2765, incorporates many advanced features, including one-touch recording plus cue and review controls for easy location of previously-recorded material.

It weighs just 1 kg without batteries and measures 13.7 mm wide, 24.4 mm long and a mere 4.5 mm deep. It operates on four penlight batteries.

The 90 mm diameter PM-dynamic speaker gives good quality sound reproduction despite the fact that it is only 24 mm thick. The unit has a maximum power output of 1.2 W.

Recommended retail price of the unit, which is available from leading electrical retailers, is $82.95.

Australian honoured with SMPTE fellowship

The Society of Motion Picture and Television Engineers (SMPTE), New York, have announced the election of Mr Arthur C. Smith of Smith & Cross Pty Ltd to fellowship in the society. He is the third Australian to be granted this highly prized fellowship.

The certificate of fellowship was presented by SMPTE president Mr Robert M. Smith at a fellow's luncheon held during the society's 121st technical conference and equipment exhibit in Los Angeles, in October this year.

SMPTE fellowships are awarded annually to members of the society who, because of their proficiency or contributions, are considered to have attained a superior rank among engineers or executives in the motion-picture, television or related industries.

Arthur Smith, now 77 and director of Smith & Cross, has been involved in the recording of sound for film since the experimental days of 1929. From 1931 to 1958 he was chief recording engineer for Cinesound Productions, during which time he formed his current company. His career has been distinguished by experimental and innovative methods of sound recording.

Audio club expands

Melbourne Audio Club recently celebrated its fifth birthday with a record membership of over 350.

The majority of members are from the Melbourne metropolitan area, with others in Victorian country areas and interstate as well as New Zealand and USA.

The club holds between ten to fifteen meetings per month, covering a number of different subjects including music listening, quadraphonics, building components and tape equipment.

In addition, there are monthly general meetings at which speeches and demonstrations of audio equipment are given.

Anyone interested in finding out more about the Melbourne Audio Club should contact Kevin Morrish (03) 723-2772 (evenings), or Tony Hohnjec (03) 561-5128.

OEM division for Pioneer

Pioneer Electronics have established an OEM Division for the purpose of selling basic loudspeakers to original equipment manufacturers.

This move was prompted by the limited availability in Australia of speakers for such specific purposes as TV sets, disco, musical instruments, PA and background music systems, cars etc, according to Pioneer.

The new division is headed by Mr Macey Kawabata of the Victorian head office.

Fluorescent power meters on new amp range

Pioneer have recently released a new series of amps designed for low power requirements.

The '08' series amps don't have quite all the features of the top-of-the-line non-switching series, but are designed along similar lines and include fluorescent power meters. The new series comprises three models, the SA-708, SA-608 and SA-508, rated at 65W, 45W and 25W per channel. Total harmonic distortion figures quoted are 0.02% (65W and 45W) and 0.03% (25W). Recommended prices range from $259 to $399.

sound briefs

VTR Copyright

Sony's Betamax can legally be used to make at-home recordings of TV programmes in the USA, according to a ruling by a Federal court judge in Los Angeles last month.

According to the judge, the Copyright Act does not give copyright holders monopoly powers over an individual's off-the-air copying in home for private, non-commercial use.

It is expected that the plaintiffs — Universal Studios and Walt Disney Productions — will appeal against the decision.

Contrary to what has been reported in the national press in Australia this ruling does not mean that recording is legal here. Australia is party to the Commonwealth Copyright Act which quite clearly prohibits off-air copying.

More Copyright

The British government has decided to take no immediate action to discourage people from taping gramophone records — despite every-increasing pressure from the phonograph industry. The industry is currently calling for a huge levy to be placed on blank cassettes, raising their price to much the same level as pre-recorded cassettes.

Efforts to place a 'spoiler' signal on records so as to make them effectively unrecordable appear to have failed.

Apart from pressing for a levy on blank cassettes the industry is now seriously considering prosecuting private individuals for breach of copyright!

Ferrograph Agency

The Ferrograph agency is now once again back with British Merchandising — who first introduced Ferrograph products to Australia back in 1948!

Also with British Merchandising is the associated agency for Neal.

Neal was founded a few years ago by Alan Helliwell, formally chief engineer/chief executive of Ferrograph who became so good at working for himself that he achieved every ex-employee's some-time-or-other ambition of buying out his boss. So it's Neal-Ferrograph now — whose combined operation is in South Shields UK.

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fog machine

New from Rock Industries — a high capacity dry ice fog machine featuring a 2400W element. The fog machine is thermostatically controlled to avoid boilover. A high output extractor is used to force the low-lying fog through an outlet tube, also allowing for ducting of the fog. Up to 5 kilos of dry ice may be used per application.

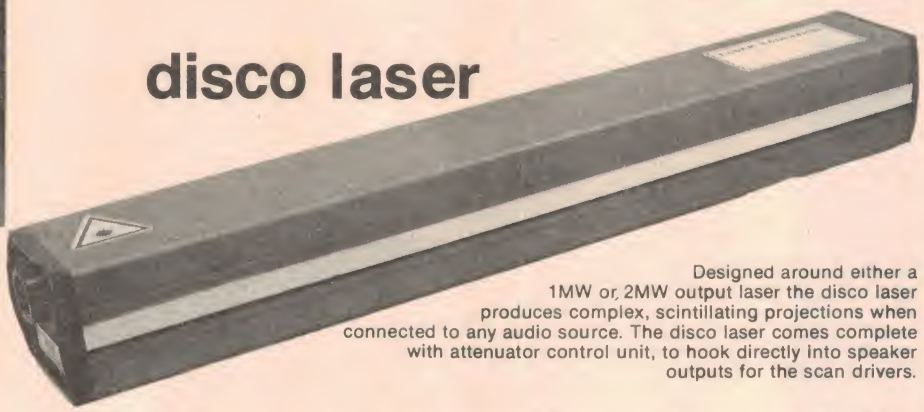
strobe controller

Finally achieve total control over your Ceitex or Strand strobes. The strobe controller is a four channel unit, capable of handling up to four strobes per channel — a maximum of 16 strobes!!! The beauty is that the controller may be effectively used with one strobe — right up to a full 16. The controller chases, flip-flops and group flashes at a variable rate and also features a built-in mic for audio operation.

space beacon

The Par 36 Hotspot is a pencil beam light, sending a brilliant white shaft of light piercing through the smoke haze in disco's. The Space Beacon uses 4, 8 or 16 Par 36 lamps — rotating! Truly a fantastic effect that can be used in many ways. Standard rotating speed, 40 rpm. Other speeds on application.

disco laser



Designed around either a 1MW or 2MW output laser the disco laser produces complex, scintillating projections when connected to any audio source. The disco laser comes complete with attenuator control unit, to hook directly into speaker outputs for the scan drivers.

laser experimenters kit

Designed for use with a 1MW lab laser, the experimenters kit is a complete course in geometrical and physical optics. A detailed 44 page manual comes with each kit, outlining 44 major experiments.

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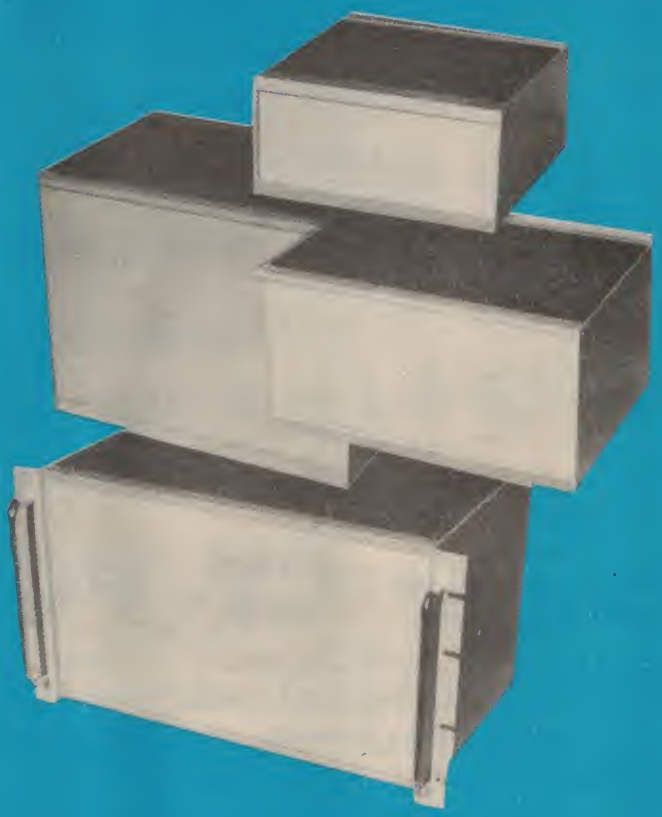

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Options available are:

1. The front and rear panels can be replaced with anodised aluminium.
2. The bottom panel can be replaced with aluminium.
3. The side panels can be of rack mounting type, with handles provided.

For further details and prices contact:

VICTORIA: TASMAN ELECTRONICS, 12 Victoria Street, Calbury 859-3082. ALL ELECTRONIC COMPONENTS, 118 Lonsdale Street, Melbourne. Neville Foley 662 3506. ELLISTRONICS 289 Latrobe Street Melbourne 3000. Jock Ellis 602-3282. J. H. McGRATH AND CO PTY LTD, 208 Lt. Lonsdale Street, Melbourne 3000. G. H. Gunn 663-3731. RADIO PARTS GROUP 562 Spencer Street, West Melbourne 3003. C. Thompson. 329-7888. ROD IRVING ELECTRONICS, 399 High Street, Northcote 3070. Rod Irving 489-8131. RADIO PARTS SOUTHERN DEPOT, 1103 Dandenong Road, East Malvern 3145. 211-8122. STEWART ELECTRONIC COMPONENTS PTY LTD, 33 Barkhill Road, Mount Waverley 3149. Stewart Day 277-0600, 277-0627. **NEW SOUTH WALES:** MARTIN DE LAUNAY PTY LTD, Cnr King and Dalby Streets, Newcastle 2300. 2-4741. DAVE RYALL ELECTRONICS, 657 Pittwater Road, Dee Why. 982 7500. APPLIED TECHNOLOGY PTY LTD, 1A Pattison Ave, Waitara 2077. Owen Hill 487-2711. **WESTERN AUSTRALIA:** MICRO-DATA P.L, 25 Brisbane Street, East Perth. ALTRONICS, 105 Stirling Street, Perth, 6000. (09) 328-1599. **SOUTH AUSTRALIA:** N.S. ELECTRONICS PTY LTD., 59 Wood Avenue, Rloleyton 5007. (08) 46-3928. **QUEENSLAND:** BALTEC SYSTEMS, 27 Cania Street, Garson, 4065. (07) 36-5182.

Pioneer CT-F650

Incorporating metal capability and a "music select system", Pioneer's medium-priced cassette deck has some marvellous features and generally good performance, but a wee problem . . .

THE INTRODUCTION of metal tape to supplement gammaferric oxide, chromium dioxide and ferrichrome tape has created a simultaneous bonanza and headache for the manufacturers of cassette decks. The CT-F650 is the first medium-priced cassette recorder that we have received which incorporates a metal tape capability. In previous reviews we have seen cassette decks whose performance borders on the ultimate and whose prices are comparable. The average audiophile obviously desires a cassette deck with modest price and superior performance that goes half way to providing some of those technical attributes that the more expensive decks provide.

Features

The CT-F650 is an attractive deck. The frontal appearance is dominated by the neat brushed-aluminium and smoked-plastic cassette deck cover, which provides an almost complete and unobstructed view of the cassette contained inside. This is flanked on the right hand side by a panel containing the fluoroscan display which also contains the three digit tape counter and four illuminated bezels to indicate the selection of record, the use of metal tape, the activation of the Dolby noise reduction system, and the selection of the 'Music Select System'. The last bezel is also activated by the recording mute switch which causes the bezel light to wink at one second intervals.

The lower section of the fluoroscan display escutcheon contains the three-digit counter reset button, four interlinked switches for selecting the type of recording tape being used and the Dolby noise reduction on/off switch. The lower stage of controls contains a cue/review lever, Pioneer Music Select System which they abbreviate to PMS. When activated in the fast forward or fast rewind mode, this circuitry searches out the next four to five second gap between individual recordings to allow the user to find individual recordings with great ease. This facility is in many respects similar to the capabilities provided in more expensive systems and is a "budget" version of the Nakamichi 680 system.

When the play mode switch is selected and the PMS lever depressed, it is only necessary to separately push down either fast forward or fast rewind for the system to search out the next gap in the programme whereupon the fast forward or fast rewind mode lever automatically de-activates and the machine goes into the play mode at that point. Other controls are the record selector lever, the forward selector lever, the stop eject button which performs two functions and the pause control which is positive and light.

The unit has two central controls which are not normally seen. The first of these is the timer start switch which allows an external mains timer to be connected to the unit. When activated in either the record mode or the replay mode, two seconds after power is applied to the unit it commences the recording or playing process which continues until the end of the tape, whereupon the unit switches itself off. This facility offers a number of attributes not the least of which is the ability to utilise the tape recorder as a means of waking one up in the morning instead of the more insidious alarm clock or the slightly more acceptable radio timer which so many people are using today.

The next control is a record mute switch which allows you to place four or five second gaps between sections of programme to facilitate finding them with the PMS cueing system. Without this control there is a strong chance that the PMS system may not operate in the correct manner and Pioneer recommend its judicious use.

The deck contains two tip-and-sleeve microphone sockets with 0.3 mV sensitivity and ability to cater for microphones of 250 ohms to 10 k impedance. The left and right input volume level control is a ganged type in which the knobs can be individually adjusted with respect to one another. An output control with an indented position at 60% for standardisation of level is incorporated.

The last facility on the front panel is a tip-ring-and-sleeve headphone jack providing 85 mV output into an 8 ohm set of headphones. This is enough for quiet listening on headphones offering reasonable efficiency. The rear of the unit is unusually sparse containing only two pairs of coaxial inputs and outputs and a mains voltage selector.

The inside of the unit incorporates one large printed circuit board near the base which contains a power supply and nearly all of the main electronics. The only sections excluded are the small pc boards containing the electronics for the fluoroscan display and the sub-board containing the selector switches and part of the electrical facilities for the tape selector mode.

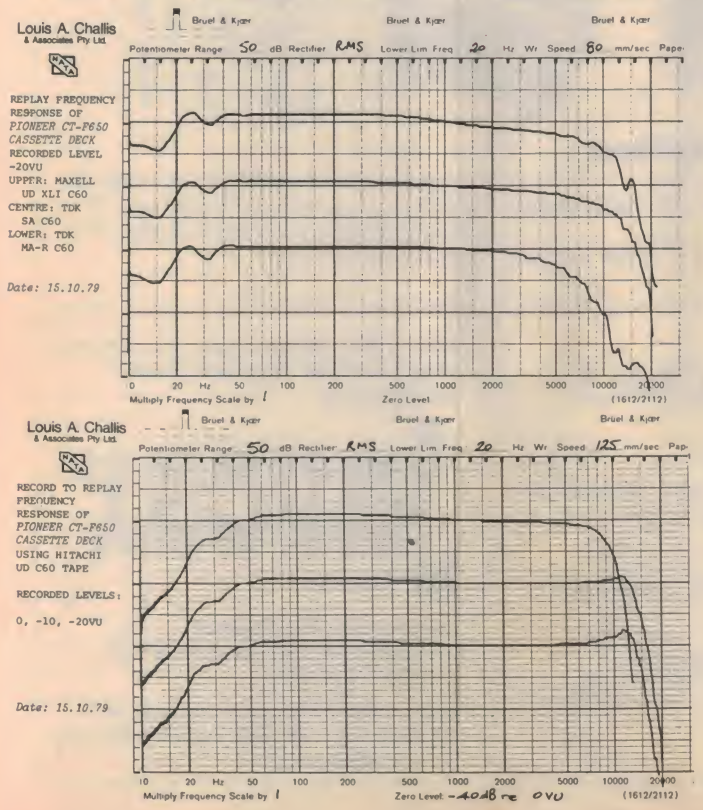
The boards are neatly laid out, clearly labelled and would present a serviceman with very few accessibility problems if the need arose to service the unit. The most attractive feature of the unit is the tape drive system which is solidly constructed from a combination of steel and acetal resin components. The unit features a well made deck drive including an unusually large fly wheel to provide enhanced speed stability. Even the eject mechanism contains a dash pot to provide smooth ejection. Mechanically, the unit is impressive and should be capable of extended trouble-free operation.

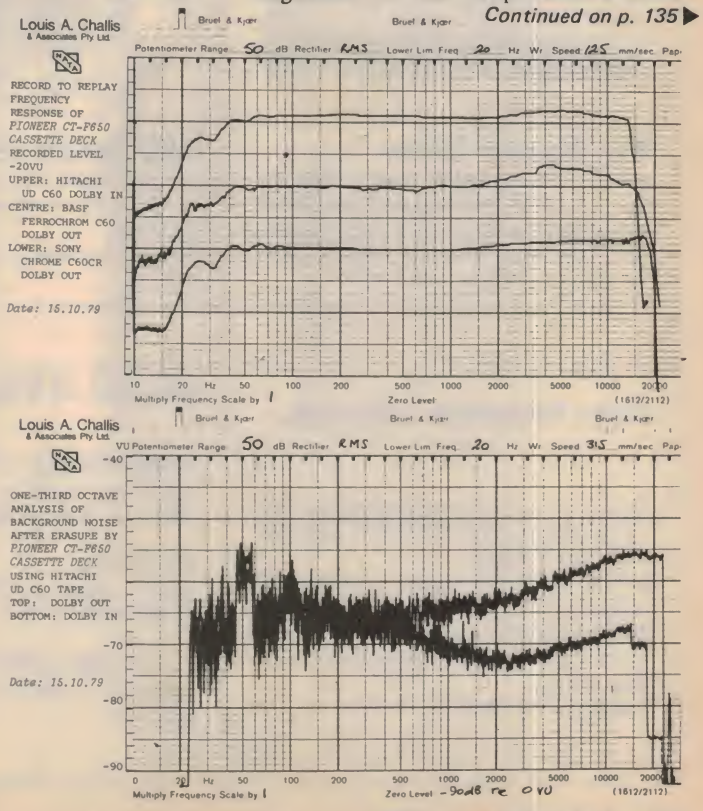
It is apparent from an inspection of the fluoroscan display that the development of electronics for this unit has reached a stage whereby the complexity of such a display results in fewer problems of incorporation than the ubiquitous VU meters created in the past. One feature which we did not expect was the amount of wiring lying between the wire wrap joints and the interconnections for the fluorscan display, tape selectors and terminal board at the rear of the cassette drive mechanism. Wiring harnesses with this number of wires still tend to be the norm with medium size production runs and with the number of interconnections required we must expect pragmatic solutions.

Evaluation

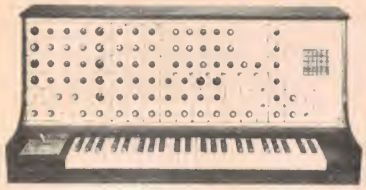
The objective evaluation of the CT-F650 presented us with more surprises than we expected. The most striking feature of the machine was that its record to replay characteristics were in general terms better than we would have expected and readily capable of achieving frequency responses ranging between 30 Hz to 14 kHz and as high as 30 Hz to 19 kHz. Surprisingly, the best frequency response was not with the metal tapes (as we would have expected) but rather with Sonychrome with which it gave an impeccable performance. Whilst the record to replay frequency response was undoubtedly excellent the straight replay response produced a rather disappointing performance. The high frequency performance dropped off rapidly over 2 kHz on all three of our special replay tapes, which alarmed us. The magnitude of the drop seemed more

Continued on p. 135 ▶





JAYCAR Pty. Ltd. — AUDIO KITS and COMPONENTS



4600 Synthesizer

This superb Studio Synthesizer offers unlimited flexibility. It utilises a Patchboard for rapid programming. Also features the "Fairlight" digital keyboard.

489 Spectrum Analyser

This 10 band LED display analyser can be used in conjunction with most equalisers for accurate acoustic compensation.

485 Graphic Equaliser

- Two channel operation with 10 octave-spaced controls per channel
- Level match control for each channel
- Available rack mounted

"CLEF" TS88 Touch Sensitive Piano

This unique 88 note piano is fully touch sensitive and offers 4 selectable piano tonal qualities plus tremelo, honky-tonk and phasing effects. Complete with pedals this is the best performance piano kit on the market today.

- Full 88 note keyboard
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"CLEF" String Ensemble

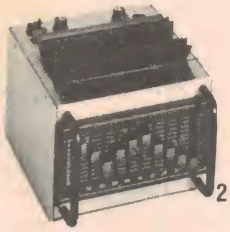
Simulates the multiple source sound of string group.

- Split keyboard facility
- 4 voices on upper keyboard.
- 3 pre-set voices on lower keyboard
- Variable Attach and Decay
- Foot controlled Swell pedal

414 Master Mixer

- 8-input channels with volume, bass, treble, pan, echo send and sensitivity select
- 2-output channels with 5 stage equalisation, VU meters, overload indication, master volume, pan and echo level

1.



2.

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A robust, compact, 100W power amplifier, ideal for use as a PA or Foldback amplifier. With the addition of a Preamp it becomes a versatile guitar amp.

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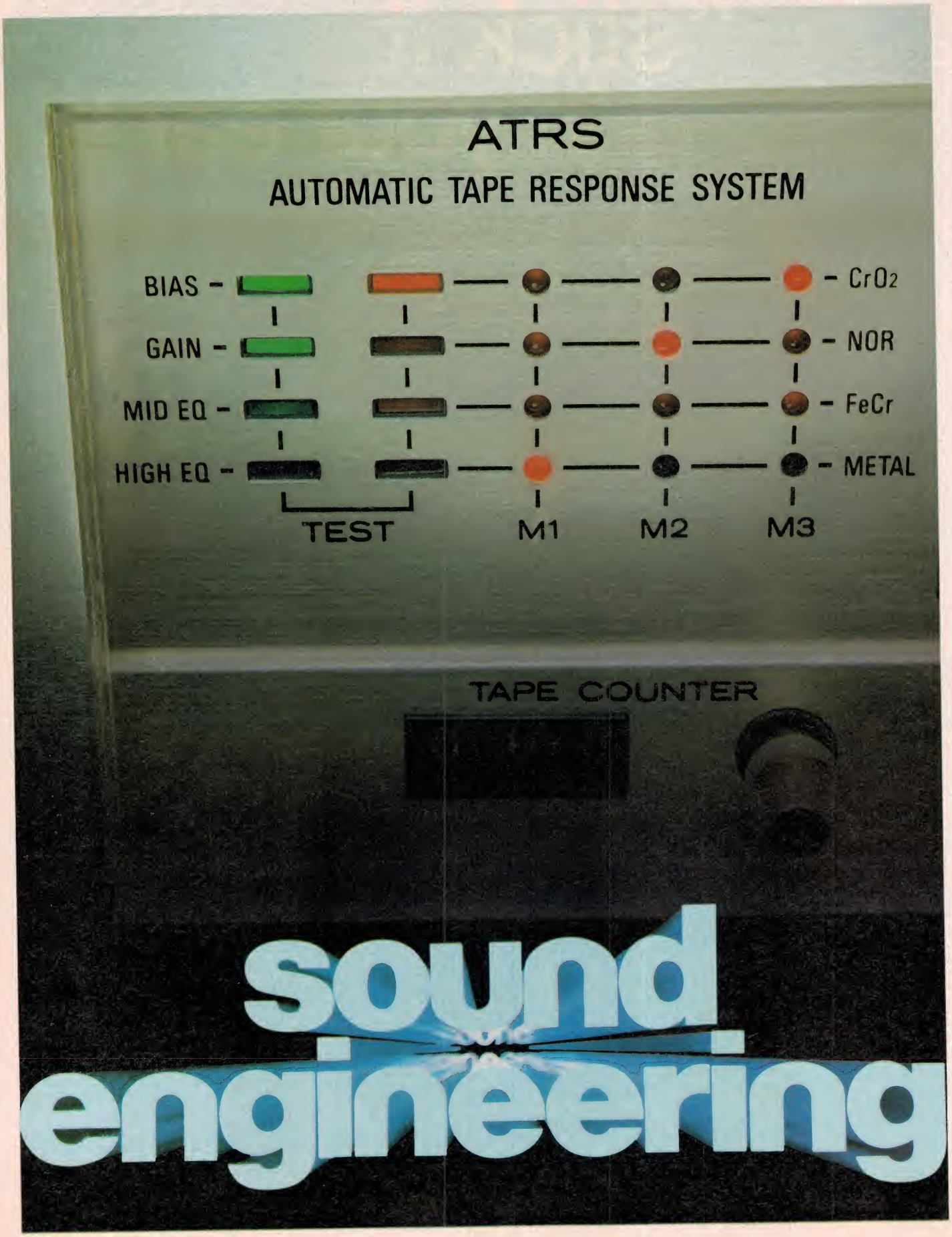
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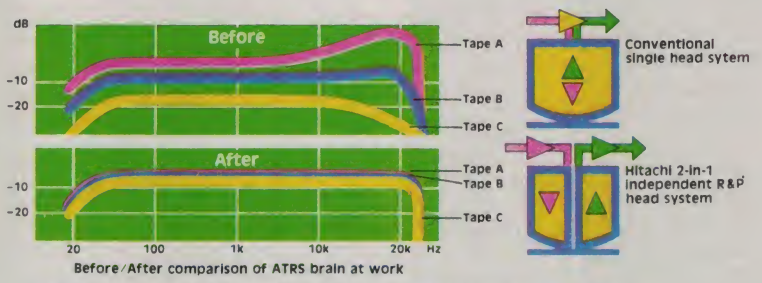
HIGH EQ
TEST
M1
M2
M3
CrO2
NOR
FeCr
METAL
TAPE COUNTER
sound
engineering

HITACHI

Hitachi's ATRS* and R&P head

This built-in microcomputer and combination head are the D-5500M Cassette Deck's little miracles.

Hitachi's D-5500M is without a doubt the most advanced cassette deck available. It features a sophisticated microcomputer that makes sure you get the best possible performance with any type of tape. Just load the D-5500M with the tape of your choice, press the TEST button, and 20 seconds later the deck is precisely calibrated to give you unsurpassed sound quality. Our revolutionary R & P combination record and playback head provides the exceptional reproduction accuracy to make this system possible. Of course, you also get the super sound benefits of the high-performance metal tapes. The microcomputer even has a memory so you can store the calibration data for three of the tapes you use most. The data can then be recalled at any time by a simple push of a button.



Before/After comparison of ATRS brain at work

Graphic illustrations are reconstructed from Hitachi Toyokawa audio laboratory data.

Other little technological miracles that make the D-5500M the cassette deck leader are a logic transport control unit that can be removed from the deck's panel to function as a wireless remote control, and a Hitachi Unitorque direct drive capstan motor that keeps wow and flutter below 0.028% (WRMS).

*Automatic Tape Response System

Professional sound through sound engineering

D-5500M

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Record Ecology in DiscKit form

— you'll Save more than money

DiscKit is a crafted walnut tray and dustcover that saves you 20% with the Discwasher products in the kit. ($55 versus $69 separately) DiscKit includes: 1) The Discwasher System Record Cleaner with D3 Fluid, 2) the Zerostat anti-static pistol and test light, and 3) the SC-1 Stylus Cleaner.

But you'll save more than money. You'll save your records from imbedded micro-dust, your cartridge stylus from abrasion and your ears from a lot of static.
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DISCWASHER, INC.

Continued from p. 129

than could be accounted for by just a random problem.

We availed ourselves of a second machine with the willing assistance of Pioneer Australia only to discover that this machine suffered from the same basic problem.

To assure ourselves that our measurement technique was not at fault we closely checked the alignment of the machine and our reference with a series of reference azimuth tapes at test frequencies of 300 Hz, 1000 Hz, 3 kHz and 15 kHz. These all showed conclusively that each of the two machines evaluated suffers from a mis-alignment of the replay head azimuth. We must presume this is due to a faulty alignment procedure in the Pioneer factory. The agreement between the two machines was most precise when measured with a phase meter connected to each channel. *Fortuitously, this problem is readily capable of being fixed.* Our advice is that any reader intending to buy the CT-F650 should insist that the supplier re-align the azimuth alignment utilising a new and reliable alignment tape.

The other important parameters of the machine were all excellent. The A-weighted signal-to-noise ratio was 49.5 dB with Dolby off and 59 dB with Dolby on. The wow and flutter and speed stability characteristics were fully acceptable. One feature which was particularly commendable was the erasure ratio of the machine. The measured performance was better than -93 dB on the gammaferric oxide tape and a phenomenal -84 dB on TDK MAR metal tape with respect to the O VU 1 kHz level.

The distortion characteristics of the machine at both 0 VU and −6 VU were *particularly impressive* and it is obvious that the designers have taken great pains to design a machine with excellent characteristics.

Connected up in our test room, the unit exhibited a number of attractive features which we immediately appreciated. The first of these was the ease with which the PMS selection system operates. This provides excellent and faultless cueing with great rapidity and unrivalled ease to the start of each section of a recording, using pre-recorded tapes and demonstration cassettes that we have produced over the past five years (before the PMS system was thought of). We were impressed to the point where we resolved that our next cassette deck must have this or a similar facility for use both in the home and in the car.

The fluoroscan display provided excellent monitoring of peak level for setting up recording levels, a facility which will obviously render the VU meter obsolete within a very short space of time. We recorded samples of selected records onto gammaferric oxide, chromium dioxide and metal tapes and were immediately impressed by the clean reproduction and performance of the unit. The frequency response on Sonychrome is truly outstanding and even the 14 kHz performance on standard tape is particularly good.

The wow and flutter figures of the unit are sufficiently low to provide clean and acceptable recording or replaying of high quality material. The addition of the timer starter switch (with an external unit) provides an added feature enabling the simplified recording of those special programmes which everybody wants to record every now and again. Hopefully those tuners won't cost too much when they finally come around.

Whilst the record to replay response of this machine was excellent the straight replay performance leaves more than a little to be desired. Over the last six months we have noticed with increasing regularity that, whilst the manufacturers align the record and replay heads to high standards, many of them are falling down on the simple replay head alignment (based on either the Philips, DIN or JIS standards).

This is, in our opinion, a fairly serious matter which all manufacturers, both large and small,.must devote more attention to. It is clear that cassette recorders are theoretically designed for replaying pre-recorded tapes and not for pirating material from other sources. If, however, we were to draw conclusions based on the care and attention paid by manufacturers to the replay characteristics of their recorders we could be forgiven for thinking otherwise.

Summary

The CT-F650 is basically an excellent machine, with above average performance at a modest price. It offers sufficient performance and flexibility to provide the type of cassette deck that most users would desire. If Pioneer rectify the distressing problem of replay frequency response we would have no hesitation in recommending this machine to most users. ●

THE CT-F650 FRONT LOADING CASSETTE DECK

Dimensions: 420 mm wide x 150 mm high x 335 mm deep.
Weight: 7.1 kg. *Price: $299*

Manufactured by Pioneer Electronic Corporation, Tokyo, Japan.

Louis A Challis and Associates Pty Ltd

MEASURED PERFORMANCE OF THE

PIONEER CT-F650 CASSETTE DECK, S.N. ZF 8400247

RECORD TO REPLAY FREQUENCY RESPONSE AT -20VU:

Tape	Dolby	Lower -3dB point	Maximum Point	Upper -3dB point
Hitachi UD C60	Out	25Hz	+2.5dB (11.5kHz)	15kHz
Hitachi UD C60	In	35Hz	+1.0dB (5kHz)	14kHz
BASF Ferrochrom C60	Out	22Hz	+3.5dB (4kHz)	16.5kHz
Sony C60CR	Out	22Hz	+2.0dB (17kHz)	19.5kHz
				17kHz

HARMONIC DISTORTION: (Hitachi UD C60 Tape)

		100Hz	1kHz	6.3kHz
0VU:	2nd	-58.2	-52.1	-52.3
	3rd	-46.7	-63.8	-71.0
	4th	-66.7	-67.5	<-83
	5th	-61.6	-70.4	-
	THD	*0.49%*	*0.26%*	*0.24%*

SPEED ACCURACY: 0.5% FAST

WOW & FLUTTER: Wow <0.1% peak to peak
Flutter 0.1% unweighted RMS
0.035% weighted RMS

		100Hz	1kHz	6.3kHz
-6VU:	2nd	-62.3	<-62	<-56
	3rd	-62.2	-66.1	-75.7
	4th	<-70	-68.2	<-80.6
	5th	<-72	-69.8	-
	THD	*0.12%*	*0.11%*	*0.16%*

NOISE: (re 0VU)

Using Hitachi UD C60 Tape	Dolby Out	-46.0dB (lin)	-49.5dB(A)
	Dolby In	-52.0dB (lin)	-59.0dB(A)

ERASURE RATIO: (for 1kHz signal recorded at 0VU)

Using Hitachi UD C60 Tape > 93dB

Using TDK MA-R C60 Metal Tape > 84dB

MAXIMUM INPUT LEVEL: (for 3% third harmonic distortion at 1kHz)

Using Hitachi UD C60 Tape +4VU

A trio for your living room

Professional musicians play the best musical instruments they can afford.
And there is now no reason why you shouldn't play their works with the best hi-fi you can afford.
Like the moderately priced Kenwood KA-405 integrated amplifier.
It's a virtuoso performance in audio engineering all by itself.
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Our KT-413 auto-sequential tuner is not simply the last word in convenience. It is accurate where accuracy counts most: in tuning FM stations.
And the KX-550 is equipped with two-belt drive, Dolby* noise reduction and separate bias and equalization. So you can make and play tapes that even a seasoned pro will admire.
The Kenwood trio of hi-fi components.
Bringing professional performance to your living room.

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The TI Programmable 58C, with plug-in application libraries and more than 170 functions and operations in scientific, engineering, and statistical fields ... now an even greater value with Constant Memory feature.

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The *Professional Program Exchange* lets you exchange programs with members. Over 1,500 programs are already available.

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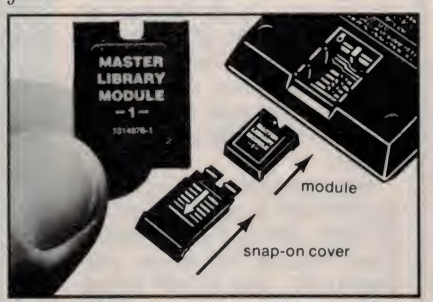

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The AIWA mini components system

Will small ever be big in hi-fi? Aiwa think small components have their place and have set out to supply a mini-sized system for tight space applications.

Louis Challis

WHILST SOME PEOPLE think that big is beautiful, AIWA and a number of other Japanese manufacturers now believe that mini components are what the market really wants and there can be no denying that most people in small flats, apartments, studies and bedrooms really do want smaller system components. The AIWA Mini Component System is presented with six basic components consisting of their STR22 AM/FM stereo tuner, SAC22 Stereo Preamplifier, SAP22 DC Power Amplifier, SDL22 Stereo cassett deck, SC-E11 compact speaker system and a small, but not miniature, semi-automatic turntable AP2200.

AIWA have gone to great lengths to circumvent a number of technical problems so as to truly miniaturise each of the main components. Thus, for example, the stereo tuner makes use of a digital display in lieu of the more conventional slide rule dial. It uses bezel LED lights to indicate the selection of AM or FM and an array of LED bars to indicate signal level in lieu of the conventional meter movement.

The preamplifier has miniature toggle switches with light emitting diodes to indicate the selection of function and provides most of the functions normally provided for on their bigger preamplifiers or main amplifiers, and with equal fidelity.

The mini dc power amplifier provides a genuine 30 W RMS power into each channel and also makes use of a series of illuminated LED bezel lights to indicate the power level. This amplifier is deceptively small but packs a very powerful electronic "punch".

The stereo cassette deck overcomes the problem of limited front panel space by inserting the compact cassette on its side in the same manner as in many car stereos. It also makes use of a LED display to indicate the recording level instead of a VU meter or fluoroscan display. The tape selector switch on this unit only makes provision for gamma-ferric oxide (normal tape) and chromium dioxide. Many users would also prefer to have the facility of selecting ferrichrome and metal oxide tapes and it may have to wait for a second generation unit to provide this facility.

AIWA's mini cassette deck, tuner, preamp and power amp are truly 'mini' — each measure a mere 210 mm across ! The semi-auto direct-drive turntable is a shade over twice that wide — 424 mm.

Whilst all of these elements function extremely well and provide truly excellent performance, the loudspeakers tend to be the limiting factor, affecting the acoustical performance. Their effective frequency response extends from approximately 100 Hz to 15 kHz as size must relate directly to bandwidth with conventionally vented loudspeakers.

The subjective performance of this mini component system is excellent and, within the size constraints of the speakers, they perform commendably well. Given a larger set of speakers this system can perform as well as any standard size system but its appetite for space and its appearance is far superior to the majority of conventionally sized system components on the market.

National think thin

National Panasonic has announced the release of two new portable radios in their "Thin Series" range.

They are the two-band horizontal style model RF-038 with LED tuning indicator and the multi-band model RF-788.

The RF-038 offers increased compactness and utility in an AM-FM receiver, combined with high performance from a unit only 27 mm thick, according to National.

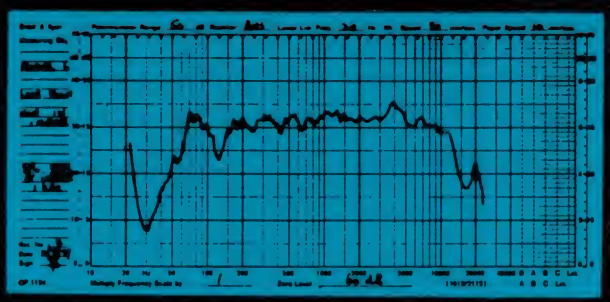
The RF-788 weighs only 460 grams (just over 1 lb) yet incorporates such features as five-band tuning (AM-FM and three short wave bands), LED tuning indicator, continuous tone control and an 80 mm speaker with 500 mW output power.

Recommended retail price of the RF-038 is $52.00 and the RF-788, $99.95. Further details from National Panasonic (Australia) Pty Ltd, 57-69 Anzac Parade, Kensington, NSW 2033.

"The sound of the Sixes' was very impressive, it was clear, live and very real.

We played a selection of Jazz pieces and were surprised just how good they sounded. Overall definition was excellent while the stereo image was precise and stable."

Extract from 'Australian Hi-Fi Stereo Buyers Guide Manual' 1979



Handles 100 watts RMS per channel.

"the heart of every good stereo system"

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Suggested retail price, $549 pair

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Technology is finally catching up with music.

There are four new, major developments in the making of advanced hi-fi receivers, and the Sansui G-4700 has all of them. Let us count the ways:

Development one

The Sansui Digitally Quartz-Locked Tuning System for accurate tuning. So unique and advanced is this system that we've already patented it. A timing counter on a quartz crystal keeps the FM Station you want to hear locked in by a circuit loop that is monitored by a digital processor. If the station tries to drift out of tune, the error is detected and converted into digital data "bits". And brought back into line.

Development Two

Our FM/AM frequency digital display and Fluorescent FM Signal/Tune Meters. This means not only is your station digitally quartz-locked the moment you stop moving the tuning knob, but that the G-4700 also provides a bright and clean digital display of the assigned station frequency. Also, tuning is smoother and easier than ever. As you seek the station of your choice, you'll simply dial that frequency on the digital display and then watch a row of fluorescent dots located to the left of the display.

Development Three

The most advanced power output indication ever made — the new Peak Power Level Display with 11 LEDs (Light-Emitting Diodes) flashing instant-by-instant output from 0.005 to 50 watts. Nothing is more accurate, easier to read and faster to respond. Or even such a pleasure to watch, since five bright red LEDs per channel,

Only hi-fi, everything hi-fi.

Sansui

G-4700

arranged in a line, flash outward from the center as power increases in the left/right outputs.

Development Four

State of the art DC, as examplified by Sansui's Pure Power DC amplifier section in the G-4700. It effectively reproduces all musical sources with lower TIM and THD, higher slew rate and faster rise time. The G-4700 delivers 50 watts per channel, min. RMS, both channels driven into 8 ohms, from 20 to 20,000Hz, with no more than 0.05% total harmonic distortion.

G-7700 120 watts x 2 (RMS) THD: 0.025%

G-6700 90 watts x 2 (RMS) THD: 0.025%

G-5700 75 watts x 2 (RMS) THD: 0.03%

There's much more to say about this brilliant receiver, and not quite the space to say it in.

But in essence, if you thought there's no way you can keep up with the wonderful world of audio engineering, Sansui urges you to please think all over again.

Our goal is zero percent dynamic distortion and 100 percent pure music.

We're getting there fast.

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G-7700·G-6700
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Our line extends from just above $200 to over $700. So you won't have to settle for less than you want. Or be forced to pay for more than you need.

And Sony isn't a newcomer to cassette decks. We've been making tape and tape recorders for 30 years. Giving us a reservoir of electronic know-how that allows us to be as technically advanced as we are today.

For example, a Sony innovation is our liquid crystal peak program meters. We were the first to utilize this LCD display – a significant improvement in accurate record level setting, and protection against overload distortion.

You'll also find an auto-reverse function. It automatically flips the head when your cassette is finished. So you can record or playback on the other side, without budging.

And for even greater flexibility Sony also builds in a 3-position tape bias and equalization switch.

At Sony we look at cassette decks as both mechanical and electrical devices. So both our electronics and transport system are designed to the most challenging specifications a manufacturer can set for itself.

Simplicity is the toughest goal

All Sony decks are designed with what we call Human Engineering.

It means that our controls are comfortable and convenient. Whether it's a sophisticated LCD display or an air-cushioned eject system.

Whether it's an advanced auto-reverse function, or a remote control capability. Or even a considerate automatic shut-off that disengages all mechanisms.

As you would expect, there's more, for Human Engineering is the way we operate.

So if this is your year to buy a deck you can either do a lot of tiresome shopping.

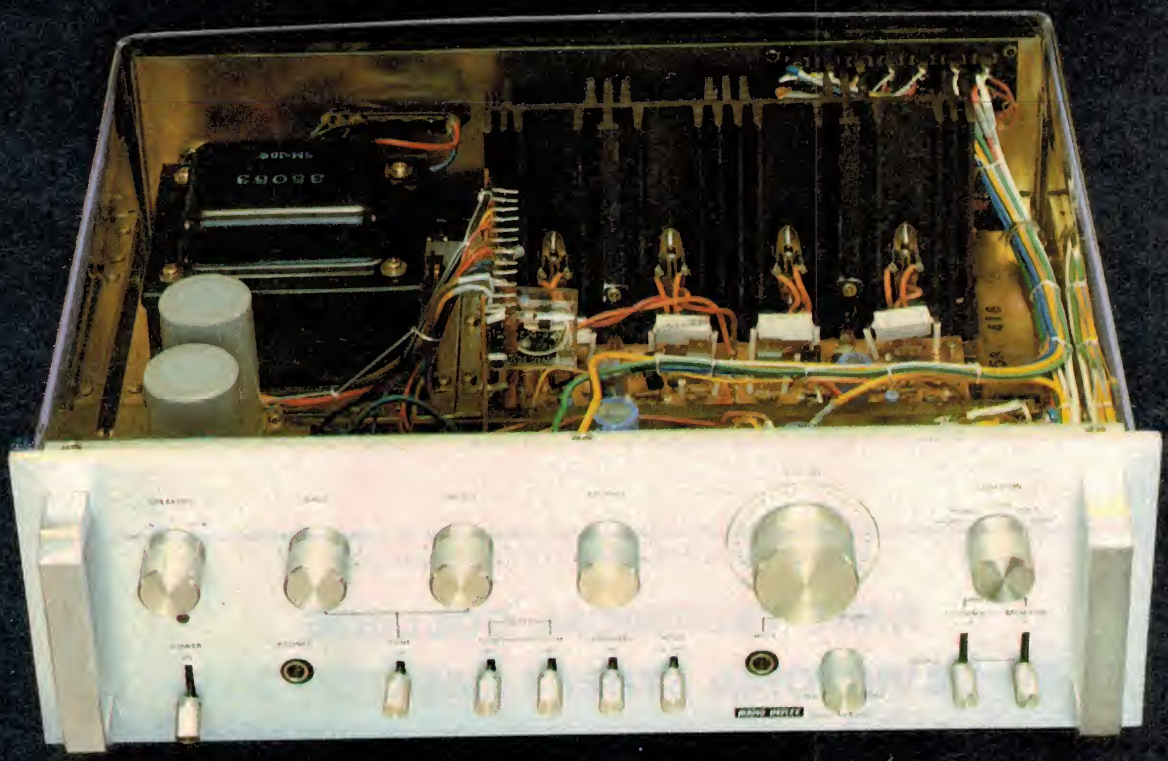
Or you can buy a Sony.

Which is the best place to start anyway.

SONY® AUDIO

AP3254

CLEAR WINNER.



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Electronics Today Intl. says... "harmonic performance... excellent, hum & noise level... excellent, TID performance ... excellent." "In all tests it either equals or exceeds all of the manufacturer's specifications." ... excellent performance...reasonable price!! Exceptional 3 year warranty!

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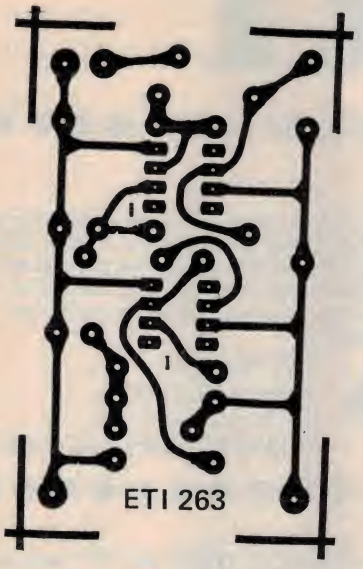
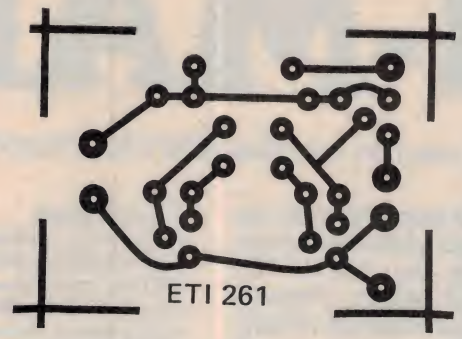
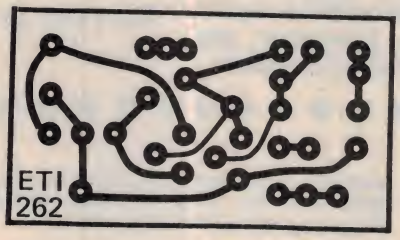
PCB's







Using ETI PCB Artwork

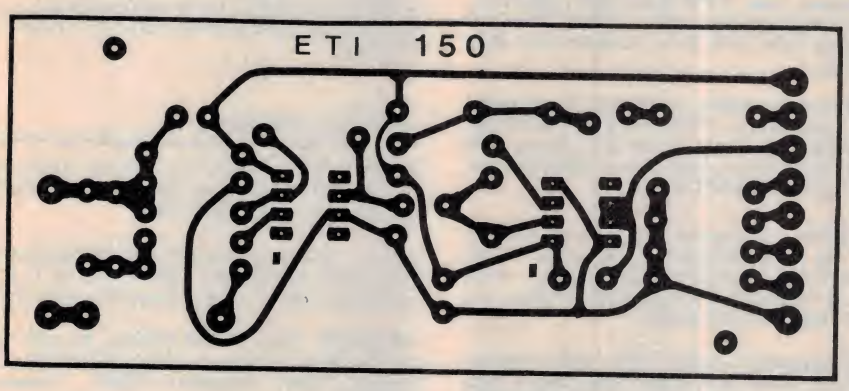
This method can be used to make negatives of ETI artwork from October 1977 on, provided the reverse of the page is printed in blue. The film used is Scotchcal 8007 which is UV sensitive and can be used under normal subdued light.

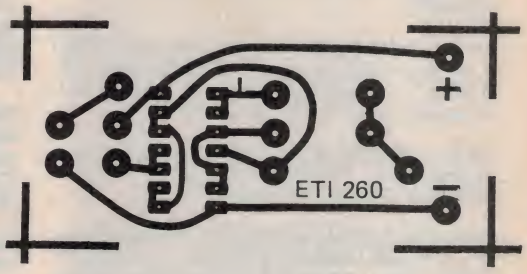
Cut a piece of film a little larger than the pc board and expose it to UV light through the magazine page. The non-emulsion side should be in contact with the page. This surface can be detected by picking the film up by one corner — it will curl towards the emulsion side. Exposures of about 20 minutes are normally necessary.

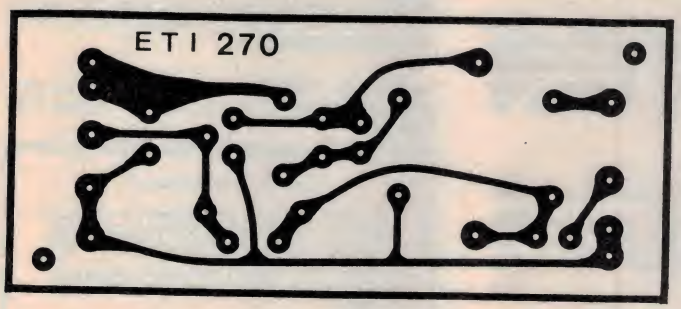
The film can now be developed by placing it emulsion side up on a table, pouring some Scotchcal 8500 developer on the surface and rubbing it with a clean tissue.

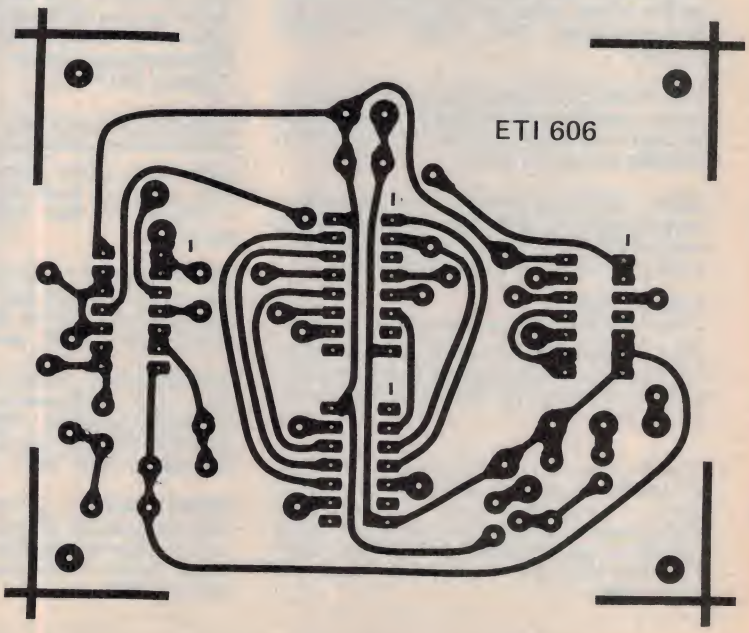
Further information on Scotchcal and pcb manufacture can be found in the September and December 1977 issues of ETI.

Please note that occasionally lack of space may prohibit the printing of blue type behind all pcb's. In this case the reader must resort to more conventional photographic techniques for pcb manufacture.









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ETI-262	Simple intercom
ETI-263	Simple egg timer
ETI-270	Solar-powered reflex receiver
ETI-150	Linear scale audio frequency meter
ETI-606	Electronic tuning fork (November issue)

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AUDIO

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MELBOURNE Audio Club meets and shares with people a common interest in Hi-Fi, Music and Audio demonstrations. For further info ring AH (03) 561.5128 or (03) 232.6811.

VALVE preamplifier Dynavector model 3000 - as new, retail in excess of $3000 will sell $1998. 12 month warranty covered by importer. Derek Pugh (02) 938.3700.

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FOR SALE: Schober electronic theatre organ. 2 x 61 note manuals, 25 pedals. Console to AGO specs. Complete with remote Leslie speaker, separate tone cabinet, reverbatape, combination action etc. Phone (02) 605.6496.

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PLAYMASTER AM FM stereo clock tuner & stereo graphic equaliser-both expertly constructed - all offers considered - phone (062) 54.2662 AH ask for Leon.

SONY TC510 professional portable stereo tape recorder, 5" reels, also main-nicad charge units $900. R Salter, 33 Belvedaire Way, Lynwood WA. 350.7254 or 364.5573.

COMPUTING

SELL: MEK6800D2 assembled. ½K RAM, full buffering, manuals; extra books, software $225 ONO. Ring (03) 749.2627, after 7 p.m. ask for Mark.

TRS-80 owners! Light Pen for the TRS-80! Communicate directly with the screen, e.g. games - no need to type in your moves. Instructions and sample prog included - plugs straight in, no modifications necessary. $23. For more info write C/- PO Box 122, Bondi Beach 2026.

TRS-80 wanted software BASIC 3 to buy or swap with my Tbug or editor assembler. Please ring (02) 888.1666, ext 433.

FOR SALE: TRS-80 or Exidy 16K memory expansion, new, 4116 type chips, $85/16K. Micro-computer ICs, new. Z80A $17; Z80 PIO $12; Z80 CTC $12. Graham, AH (03) 89.6918.

HP25 programmable calculator 8 memories 49 program steps. Complete with Instruction and Application books and AC charger $55 ONO. Greg Smith, Bank Street, Meadowbank NSW, phone (02) 807.3312.

WANTED: Computer Interface (Solenoids etc) for IBM Selectric Typewriter. Suit either S-100, RS-232 or Centronics. Sean Corr, 9 Witchwood Close, South Yarra, Vic 3141. Tel (AH) 267.3246.

2650 computer system 7Ks with cassette interface, built into desk, Sony video tape recorder, Sony TV monitor. The lot $1400 ONO. Phone 93.4679 AH.

MICROPROCESSOR programming sheets, 500 for $10 or 100 for $2.50. Also available quick hookup 2650 op-code and nmemonics, subroutine function sheets. Brisbane Youth Microcomputer Group, C/- 14 Cupania St, Algester, Qld 4115.

COMMUNICATIONS

HAM radio study materials novice kit $15, 500 questions book $2.50, WIA produced. T Wilson, PO Box 109, Toongabbie 2146. Send now!

FM320 UHFCB with scanner, preamp, variable mute, 2 aerials, base station microphone. Performs well. $270 Greg Smith, Bank St, Meadowbank, NSW, phone (02) 807.3312.

AUSTRALIAN Radio DX Club for shortwave and mediumwave DXers. Monthly magazine published. Write for details to PO Box 67, Highett, Vic 3190 or PO Box 79, Narrabeen, NSW 2101 with 30 cent stamp.

R5223 receiver, ex Australian Army and manufactured by TCA in 1965. Want circuit or any other information. Lionel L Sharp, 19 Kelso Street, Chermside, Qld 4032. Phone (07) 59.1945.

KENWOOD 2200G 2m FM transceiver 12 chan. AC/DC $100 also Kenwood TS700A all mode 2m. Base AC/DC transceiver Vox 3 MG30S $550 ONO (02) 498.7867.

I buy your QSL cards in good condition from Antarctic Stations. Please send with price or for quote to Dick Richter, Box 113, Redcliffe Qld 4020.

MISCELLANEOUS

FOR SALE: EA and ETI magazines. EA Jan76 to date, ETI May 76 to date. Bargain at $30 the lot. Phone (02) 521.7169.

SELL: Miniscope and Mico (10W) soldering irons with transformer. Must sell, all in A1 cond, $30 ONO. Contact Craig (02) 498.4594.

WANTED: Two 6 VDC motors. No load 1A startup 10A. Contact: David Michalzik, 21 Craigie Road, Newtown 3220. Needed urgently!

250 new boxed valves most suit TV repairs $50. K R, PO Box 279, Warrnambool 3280 AH (055) 69.2355.

WANTED: Oscilloscope BWD 539D or similar. After 6 p.m., ask for Brian. Phone (03) 56.5478.

You have to be very confident before you claim anything will permanently remove static electricity from a gramophone record.

Today anyone who makes a claim on behalf of a product had better be able to prove it. Or faster than they can say Norman Jesky they'll be in big trouble.

Derek Pugh of Concept Audio confidently introduces to Australia a remarkable new product. It's called Permostat. And it permanently renders records free of static electricity.

What is this thing called static?

The contact of two dissimilar materials is liable to cause an exchange of electrical charge. Thus when a record is removed from its sleeve, subjected to cleaning by a pad or brush or is in contact with a stylus, the record surface is inevitably left in a highly charged state.

What are the effects of static?

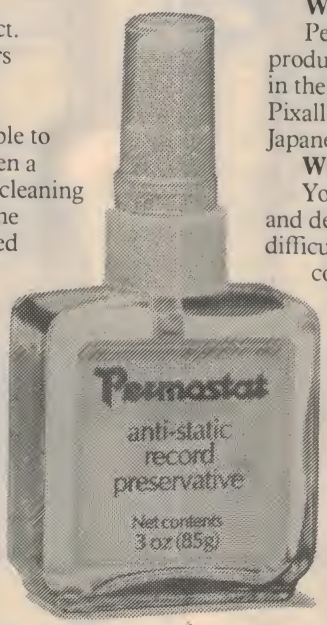
Not unlike a common magnet attracting iron particles, static scavenges and draws dust particles onto the record surface where they can be pushed along the grooves, creating various degrees of distortion. A highly charged record surface can cause micro discharging, uneven cartridge attraction and alteration of the stylus tracking force, resulting in wow and flutter, distortion and record stylus wear.

Permostat?

Permostat is a uniquely formulated fluid which when applied to a record totally and permanently eliminates static.

How permanent is permanent?

It is claimed that playing a record one hundred times corresponds to the normally expected use of a given record by a consumer. This is also the number of plays used by record companies for evaluating their products. Tests prove that Permostat eliminates static for at least one hundred continuous plays.



Are there any adverse effects?

Laboratory tests confirm no detectable change in sound quality, surface noise, frequence response and fidelity.

Who produces Permostat?

Permostat has been researched, developed and produced by the British firm, Milty Products, a leader in the field of record care and maintenance, whose Pixall record cleaner has already won the coveted Japanese Grand Prix award.

Where can I buy Permostat?

You'll find Permostat in all good hi-fi, audio, record and department stores. However, if you have any difficulty in obtaining Permostat, please fill in the coupon below.

Dear Derek Pugh. Permostat had better permanently render my records free of static. Or I shall be making one or two phone calls.

(BLOCK CAPITALS PLEASE)

Name _____

Address _____

_____ Postcode _____

Please supply (state quantity required) _____

Permostat Kit(s) @ $15.95 ☐ Permostat Refill @ $9.95 ☐

P&P Incl. I enclose a Cheque/P.O. value $ _____

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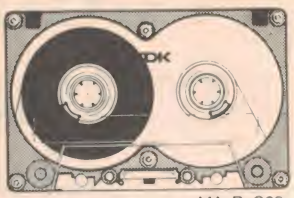
CA302

Permostat by Concept Audio.

TDK-the great name in cassette tapes

METAL — MA-R developed for decks with Metal Bias position with an outstanding capacity to record high level signals without risk of tape saturation.

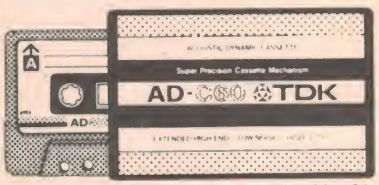


MA-R-C60

SUPER AVILYN — SA handles exceedingly high signal inputs without distortion due to increased MOL providing full dynamic range for both recording and playback.

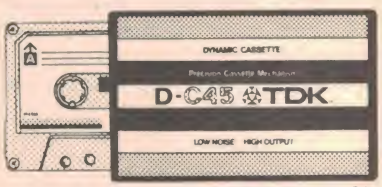
SA-C 60, 90

ACOUSTIC DYNAMIC — AD has high MOL and is capable of recording playing pop rock and jazz music sources with plenty to spare but does not require special bias and equalisation settings.



AD-C 45, 60, 90, 120

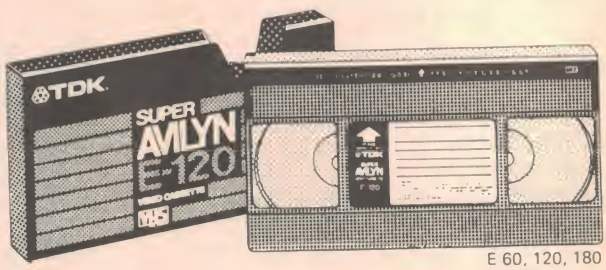
DYNAMIC — D offers sound reproduction quality which meets the budget-minded demands of many home recordists.



D-C 45, 60, 90, 120, 180

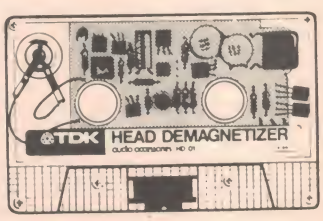
TDK's super precision cassette mechanisms feature —
• Leader tape effectively acts to clean heads • Moulded cassette shell • Double clamp system prevents tape deformities • Pressure pad provides reliable tape contact on the head • Liner enhances tape run and durability • Guide roller ensures parallel tape travel and stable transport.

SUPER AVILYN VIDEO produces crystal clear and colourful pictures with playback images. Excellent durability for use time and time again with compatibility for unrestricted use in VHS system VTR's.



E 60, 120, 180

HD-01
HEAD DEMAGNETIZER — designed by TDK for easy, convenient head demagnetisation of any cassette deck insuring crystal clear, perfect recordings every time.



For more information or a copy of the "TDK guide to better recording" phone or write.

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DICK'S FANTASTIC 55 WATT SYSTEM

ONLY $799 Terms available to approved applicants

For the first time, Dick is offering the superlative performance of his top Hi Fi system, incorporating the superb Dick Smith 55 watts rms per channel stereo amplifier, the 12" Playmaster 3-way speaker system with in-built control for the midrange and tweeter and the Sanyo belt drive turntable with servo control, magnetic cartridge, base and cover - at a price that will astound you **PLUS** a matching stereo AM/FM tuner (worth $239) absolutely **FREE!**

Post & Packing $5.50 anywhere in Australia

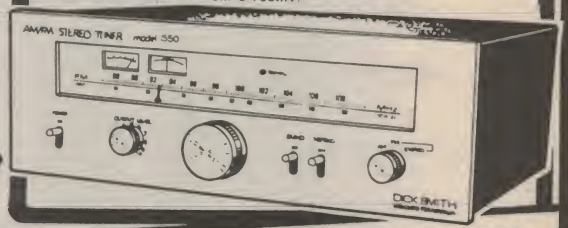
BUT THAT'S NOT ALL!

THIS TUNER WORTH $239 ABSOLUTELY FREE

(When you buy the system)

DELUXE AM/FM TUNER

SPECIFICATIONS: 1 FET, 1 stage RF amplifier, 3-gang variable capacitor, 5 stage limiter, PLL MPX ★ Frequency range 88-108MHz ★ Sensitivity IHF 1.9uV ★ S/N ratio 70dB (mono) ★ Total harmonic distortion 0.2% (mono) @ 1kHz, 0.3% (stereo) @ 1kHz ★ Frequency response 30Hz to 15kHz ★ Separation 40dB @ 1kHz. The AM section has a frequency range of 525-1605kHz. Audio variable from 0-750mV.



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SAME FANTASTIC DEAL ON 30 WATT SYSTEM

And yet another fantastic bargain! The Dick Smith 30 watts rms per channel amplifier matched to the Playmaster 10" 3-way speaker system and Sanyo servo belt drive turntable. Looks good, sounds fantastic and with your purchase you receive the matching AM/FM stereo tuner absolutely **FREE!**

FANTASTIC VALUE $683 Terms available to approved applicants

Post & Packing $5.50 anywhere in Australia

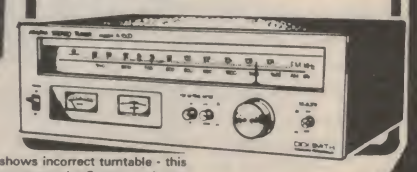
Prices correct and products in stock at press time

Illustration shows incorrect turntable - this system incorporates the Sanyo as shown in the 55 watt system illustration.

PLUS FREE TUNER WORTH $189

(When you buy the system)

SPECIFICATIONS: FM tuner section Frequency range 88-108MHz ★ IHF sensitivity 1.8uV ★ Selectivity 60dB ★ Stereo separation 40dB @ 1kHZ ★ Frequency response 30-15,000Hz. AM section Frequency range 530-1605kHz ★ Sensitivity 48dB ★ Selectivity 35dB @ 1kHz ★ Semiconductors 1 FET, 3 ICs, 5 transistors, 3 diodes and 1 LED. Dimensions (same as amplifier) 400(w)x135(h)x290(d)mm.



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DSE654

Tandberg — European trendsetter in 1980s hi-fi gear

Brian Dance

Tandberg, who were first out with a metal tape deck over 12 months ago, recently released their new range of hi-fi equipment with design and performance features that seem poised to set the trend for European gear for the early '80s. Report from our European correspondent.

THE NORWEGIAN-BASED Tandberg Company, well known for their high quality audio equipment, have recently announced the introduction of a 3000 series of separate units which supplement their 2000 series of receivers. The new 3000 series comprises the TPT 3001 programmable tuner, the TCA 3002 control amplifier and the TPA 3003 power amplifier. Designed by Bruno Oldani, these units are for the upper end of the market, although reasonably priced, and have been styled to fit into metal cases of slim dimensions.

The TPT 3001

The TPT 3001 programmable tuner has facilities for eight FM pre-set tuning frequencies. The system is based on a voltage synthesis principle which incorporates a special analogue servo loop which is claimed to provide both a maximum signal-to-noise ratio and high frequency stability. A series of digital pulses is generated, integrated and smoothed to provide the exact voltage required for the varicap diodes in the tuner.

The FM front-end employs eight tuned circuits to provide more than 135 dB rejection of spurious signals (including the image frequency). Tandberg claim the usable sensitivity at the input is 0.85 μV with a mono signal and the stereo threshold is quoted as 5 μV. The signal-to-noise ratio with a 500 μV signal is 93 dB (mono) and 80 dB (stereo), but with 5 mV input signal is 90 dB in the stereo mode. Dual-gate MOSFETs are used in the two RF stages and the mixer.

The oscillator circuit is completely isolated by two buffer stages to eliminate tracking problems with high level antenna signals. This is necessary to achieve a 93 dB signal-to-noise ratio on mono reception.

The IF gain block consists of seven differential amplifier stages which provide an AM suppression ratio of over 70 dB. Care has been taken in the circuit design to ensure that the limiting is perfectly symmetrical. In order to

provide a 'no compromise' performance, the filter circuitry can be switched to three different bandwidths known as 'wide', 'normal' and 'narrow'.

In the wide position, there is 25 dB attenuation of signals at the ± 400 kHz points, but 0 dB for the ± 200 kHz points. In the normal position, the corresponding figures are 85 dB and 12 dB, whilst in the narrow position there is 50 dB of attenuation at the ± 200 kHz points.

In the normal position distortion is quoted as 0.08% at 1 kHz and about four times greater at 10 kHz. Distortion is still less in the wide position (by a factor of two to three), but is about ten times greater in the narrow position. Tandberg specify the frequency response as flat from 30 Hz to 15 kHz to within +0.2 dB and −0.5 dB in both the mono and stereo modes in any position of the selectivity switch.

A continuously variable muting adjustment allows the muting threshold to be set anywhere between an input voltage of 1 μV and 10 mV. The TPT 3001 incorporates meters for signal strength and centre tune, display of the pre-set programme and an automatic noise cancelling circuit. The signal strength meter can be set to cover either a range of 0.3 μV to 1 mV or 300 μV to 1V at the input.

The stereo separation between the two output channels is quoted as 60 dB at 1 kHz and 50 dB at 10 kHz. Output filters provide a 95 dB rejection of the 19 kHz pilot tone and more than 120 dB rejection of the 38 kHz regenerated sub-carrier according to the specs. Intermodulation distortion is about 0.1% in the wide and normal bandwidth settings.

Thus, the specifications of this tuner are truly excellent (just compare them with others!), but contain no useless 'gimmicky' features.

The TCA 3002

This control amplifier employs 116 discrete transistors specially selected for the required parameters. The unit has 24 amplifying stages and four voltage stabiliser circuits which are all short-circuit protected. The transistors employed in the input stages are selected to provide the optimum signal-to-noise ratio even when used with a high source impedance. Push-pull output stages are employed in circuits which can provide relatively high output currents for a pre-amplifier unit.

Separate buffer stages are used for every input circuit. Thus the input selector switch handles only fairly high signal levels and any noise voltages generated during the operation of the switch are totally masked by the programme material. Input sensitivity is given as 165 μV into 1k ohm or 2 mV into 33 k, 47 k or 100 k ohm in the case of the phono inputs and 150 mV into 47 k ohm for the two tape inputs, the tuner input and the auxiliary input, all these values being for a 0.5 V output. Total harmonic distortion is quoted to be 0.004% for signals fed to any of the inputs.

Tandberg's new 3000 Series of separates incorporate their "state of the art" technology featuring cabinet and panel designs by Bruno Oldani.

The tone controls can provide 10 dB of bass and treble boost or cut at 50 Hz and 10 kHz respectively, whilst a subsonic filter with a slope of −12 dB per octave provides a −3 dB cut at 15 Hz. Signal-to-noise ratio is specified as 97 dB for the high level inputs, 74 dB and 80 dB for the phono inputs.

The TPA 3003

The TPA 3003 is a power amplifier providing two channels rated at 150 W RMS each, over a power bandwidth of 20 Hz to 20 kHz at a total harmonic distortion of 0.02% into an 8 ohm load. The frequency response is flat from 5 Hz to 100 kHz to within ± 1.5 dB according to Tandberg.

An interesting feature of the power amplifier is the individual peak clipping indicators for each channel. Intermodulation distortion is quoted as 0.02% and the damping factor as 260 into an 8 ohm load for the frequency range 20 Hz to 1 kHz.

The TCD 440A

Another new product from Tandberg is their TCD 440A cassette deck which incorporates not only the Tandberg Actilinear Recording System, but also their new Dynamic Equalisation System (DYNEQ). The Dyneq system is at present unique to the TCD 440A and provides an extra 12 dB maximum output at 10 kHz; in addition, it is claimed that it drastically reduces the intermodulation distortion.

The high frequency overload level found in most cassette recorders produces many complaints from users and is not simply a matter of reaching a point where the tape can hold no more signal. At the upper frequencies excessive input levels not only produce excessive distortion, but actually lower the signal level achieved on playback since, when the saturation point is reached on the tape a higher input level produces less output. The new Dyneq circuitry adjusts automatically the recording pre-emphasis system so as to maximise the treble response and to simultaneously minimise treble distortion.

The TCD 440A incorporates a unique erase head which will produce 80 dB erasure at 1 kHz and over 60 dB at 100 Hz according to Tandberg. The frequency response is rated at ± 3 dB over the range 30 Hz to 20 kHz and the signal-to-noise ratio 70 dB ('A' weighted) with top quality chromium dioxide or metal particle tape.

The meters in this deck are peak reading with a second scale which is calibrated to reflect the high signal levels one meets with metal particle tapes. The deck even incorporates a built-in 10 kHz test oscillator for optimising the performance with all types of tape, whilst front panel controls are provided for conventional iron oxide tape, chromium dioxide tape and metal particle tape. A single pushbutton provides a facility for the instantaneous comparison of the input and the recorded signal.

The TCD 440A deck has a built-in Dolby noise reduction system which also has an FM position for providing the proper response for monitoring or recording FM broadcasts.

The tape transport system employs three motors and is controlled by a PROM logic system which incorporates a 'flying start' capability. An infra-red pulse code modulation system is available for users who require remote control of the deck.

THORENS - Outstanding Transcription Turntable Technology

The precision Thorens TD115 turntable is one of the excellent range of Thorens turntables.

THE TD115 FEATURES:

• New 4 point ortho-inertial suspension • Servo-controlled electronic belt-drive system with DC motor 72 Pole Tacho generator • Load correcting automatic pitch control (APC) • ISOTRACK TP30 tone arm with very low effective mass of 8 grammes • Shock-proof jewel bearings for extremely low friction • Low resonance tone arm tube utilising "split wave technology" • Friction-free velocity-sensing electronic shut-off • Rumble unweighted — 48 dB to Din 45539 — Rumble weighted — 68dB to Din 45539

THORENS

WHARFEDALE

E70 Speakers

The Wharfedale E Series of speakers are exciting in design concept, integrating beautiful looks, classical accuracy and high output capability.

A FEW FACTS

• Power Handling (DIN 45573) — 100 watts • Sensitivity 94 dB at 1 watt at 1 metre • Frequency Response 50 Hz — 18 KHz ±3 dB • Crossover Points 300 Hz & 7 KHz at 6dB & 12dB per octave • Bass loading — Optimised reflex Maximally flat fourth order — Butterworth • Dimensions — H32". W 13½. D 14" • Weight — 70 lbs each enclosure.

ALTEC LANSING

Model Nine Speakers

A special book-shelf speaker that's elegant in design and outstanding in performance.

FEATURES INCLUDE:

• Speaker Components — Low Frequency: 12" bass driver Mid Frequency: 6½" frame cone driver High Frequency: 5" frame cone driver • Crossover Frequency: 800 Hz, 7 kHz • Enclosure Type: Vented • Sensitivity: 93 dB SPL • Frequency Response 40 Hz to 20 kHz • Long Term Broad Band Maximum Power: 60 watts • Finish: Hand-rubbed oiled walnut • Dimensions: 26½" H x 17½" W x 15" D (67.3cm H x 44.5cm W x 38.1cm D)

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To be brief.

The AR9 presented the concept of an array of vertical mid and highrange drivers to give a very precise stereo image.

This design feature is now part of all AR Vertical Speakers.

The AR9 introduced the AR Acoustic Blanket™ which absorbs reflections from the front of the enclosure and noticeably smooths high end response...another innovation that is now part of all AR Vertical Speakers.

Placing woofers in the side of the enclosure (and thus close to the wall behind the speaker) improves bass response dramatically in the AR9. Side-mounted woofers and newly designed slim enclosures accomplish the same objective in the other AR Vertical Speakers. Liquid-cooled high end drivers give the AR9 terrific power handling capacity.

All the AR Vertical Speakers share these drivers with minor design variations.

So there you are.

Four of a kind (left to right): The AR92, a three-way system with new 10" woofer at about $475. The AR90, a four-way system with a pair of 10" woofers at about $825 each. The AR9, a four-way system with a pair of 12" woofers about $1350. And the AR91 with 12" woofer at about $575 each.

AR
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ACOUSTIC RESEARCH AUSTRALIA. 3 Ford Street, Greenacre, NSW. 2190. Phone 642-2595

A buyer's survey of hi-fi retailers

One person's experiences and impressions of what happens when you walk into a hi-fi retailer and say "I'd like to look at . . .

IN 1975 our then-associated magazine, Hi-Fi Review, surveyed a number of hi-fi stores around Australia to find out just what sort of service was being offered.

The results were a bit of a shock – both for the magazine and the trade generally. Most retailers' staff baffled purchasers with masses of generally-incorrect pseudo-technicalities, and generally the best sales service came from the major department stores rather than the specialist trade.

As the best part of the five years has passed since then we felt it was time to do it again – here are the results.

Our 'buyer' was Tanya Buchdahl. Tanya is one of Australia's best known classical music reviewers. She has a professionally-gained theoretical and practical knowledge of music and is thoroughly conversant with all aspects of audio equipment. Tanya lives just outside Brisbane – she is married to the conductor of the Queensland Symphony Orchestra.

Because of Australia's restrictive and non-uniform laws of defamation we regret we are unable to identify the retailers surveyed.

Retailer No. 1, Sydney

When I last visited this store some years ago, the best advice offered was "make a list of what you want and come to us for the best price". The difference this time was enormous, a real effort was made to be helpful (the addition of a carpeted listening room may also have had something to do with it).

The salesman was very pleasant and did seem fairly interested (very interested, really) in helping me choose the right system. He asked whether I had a particular set-up or price range in mind, and I told him I wanted to spend about $1500.

He started by showing me a special offer Akai system, but didn't make a big thing of it, then took me to the listening room. He recommended an Akai amp/tuner on special offer, a Yamaha or preferably Akai turntable, and an Akai cassette for starters, giving me an informative and fairly accurate spiel on these, pointing out that speakers had by far the most effect on the sound you hear and are far and away the most subjective part of one's set-up. He then asked what sort of music I liked (classical) and what size my lounge room was (average), whereupon he produced a fairly beaten-up-looking classical record to demonstrate a range of speakers.

He demonstrated five pairs of speakers: JBL, Tannoy, Yamaha and two B&W, giving me plenty of time to listen to each closely, and not turning the volume up too loud – which is saying a lot, as I am particularly noise-sensitive. All this took about three quarters of an hour, but I had an appointment and had to leave. He suggested that I should come back, bringing one of my own familiar records, as he'd be happy to give another demo any time.

The system recommended, the above components plus one of the speaker pairs, would have been around the $1500 I specified – he didn't try to push my expenditure up at all.

Though this store (at least at the time of my visit) seems to specially favour Akai goods, their general range is quite wide and their service is excellent. Not at all a bad place to shop.

Retailer No. 2, Sydney

It took a long time before anyone came to serve me, even though the shop was completely empty of other customers – maybe this is "not putting on the pressure"? The salesman, once I had attracted his attention, asked me how much I wanted to spend, and when I said $1500 he immediately showed me a Marantz special offer. This included a cabinet (not a rack mount) which he didn't ask me if I wanted but which was well over $100 worth.

He was pretty insistent about the Marantz set-up, even pointing out the light which shows when the power is on or off (for the benefit of a dumb female?). He didn't bother asking what size room I had till later, or what sort of music I liked until very much later.

He demonstrated the set-up, telling me what a flat response the speakers had and so on and so forth, but because he had them sitting on the floor, the bass was horribly lumpy, and on that evidence I wouldn't have given ten bob for them. After I'd indicated that ▶

I wasn't rave-keen on that system, he recommended another – Marantz of course. After a lot of talk he demonstrated a few other speakers, again including Marantz, and some called "American Electric" (?) which, according to him, were "much too bright", although I found them not as bright as the Marantz.

I finally settled on some Mordaunt Shorts, though how I did so I'm still not sure, as the record he played was (a) too loud, and (b) pretty distorted, which was only partly due to the record itself as I noticed when he switched turntables.

This store didn't have a separate listening room, and the showroom acoustics struck me as rather strange – not anything like anybody's living room. At least they demonstrated to only one customer at a time. The system we decided on worked out at $1560, not too far off my budget.

One real benefit offered here is a fifteen-day home trial to see if you like what you've bought – but without being too cynical, it's possible you'd need it.

Retailer No. 3, Sydney

I'd say that the word which best describes this store is "overkill"; not only do they have the largest stock of hi-fi gear I've seen this side of Singapore, but the layout makes it seem at least twice as much again.

The treatment I got from the salesman could also be classed as overkill. He did ask what sort of music I liked, and how much I wanted to spend (again, classical and $1500), but it turned out to be pretty irrelevant. We went into the listening room, where I was subjected to the lengthiest spiel I've ever heard on hi-fi, some of it interesting, some of it obvious, and some of it unmitigated obfuscation – a lot of stuff about the sound of Boesendorfer pianos sounding the same no matter what you record them with, or something along those lines. I let the wave of words surround me (I hope I didn't cause him to lose his place, although I'm sure he memorised it), in one ear and out the other, and amused myself by surreptitiously eyeballing the gear.

He was, however, the only salesman who demonstrated that there really *can* be a difference between amplifiers of much the same power rating, which was one of the few really interesting parts of the demo. He couldn't find a classical record, but instead used an Oscar Petersen solo jazz piano, which was at least a passable substitute.

We went through about five or six pairs of speakers, including a couple of JBLs, AR and Gale, but he omitted to mention the prices as we went along. At the end of nearly an hour he was just about to switch to a violin record which, I feared, would have meant a whole new spiel about how the sound of a Guarnerius doesn't vary, only the gear, but again I had an appointment elsewhere which I must say I was heartily glad of.

I suppose it is good that a salesman is prepared to spend so much time on what was, after all, not exactly a state-of-the-art purchase, but too much is as bad as too little. At any rate, I finally selected the Gale speakers. "Oh", he said, "you have expensive tastes!" Only when I asked him to explain did he let me know that they were $1300 a pair, which doesn't leave a lot of change out of $1500.

They system eventually decided on consisted of the Gale 401s ($1300), Harman Kardon 505 ($599), Dual 621 TT and cartridge ($359). The turntable he actually demonstrated, at great length, was an AR. This added up to $2258, and that didn't even include a tuner or cassette! (Although he suggested the Harmon Kardon 1500 at $299). As I said before, a case of overkill.

Retailer No. 4, Sydney

This was, on balance, the best store I went to. I came out with a system I would not have bought had I genuinely been in the market for a system, but I felt that I had been very fairly treated. The salesman did not over-explain, and was perfectly happy to mess about with speakers, stands and leads for quite some time, according to my every objection – which were plenty. This made an enormous difference to the AR14 speakers, the sound of which improved dramatically after they were shifted onto stands – a difference which no other dealer bothered to point out or arrange, even when leaving them on the floor was to their own disadvantage.

This salesman was so interesting to talk to that I was hard put to remember that I was supposed to be acting fairly dumb about hi-fi. I discussed my own system at length, passing it off as "a friend of mine's". He genuinely appeared to be of the opinion that speakers in the $1000-$1500 bracket (e.g. Yamaha or AR14) were as good if not better than speakers over $2500, as distinct from mouthing such sentiments merely to avoid looking like a rip-off artist.

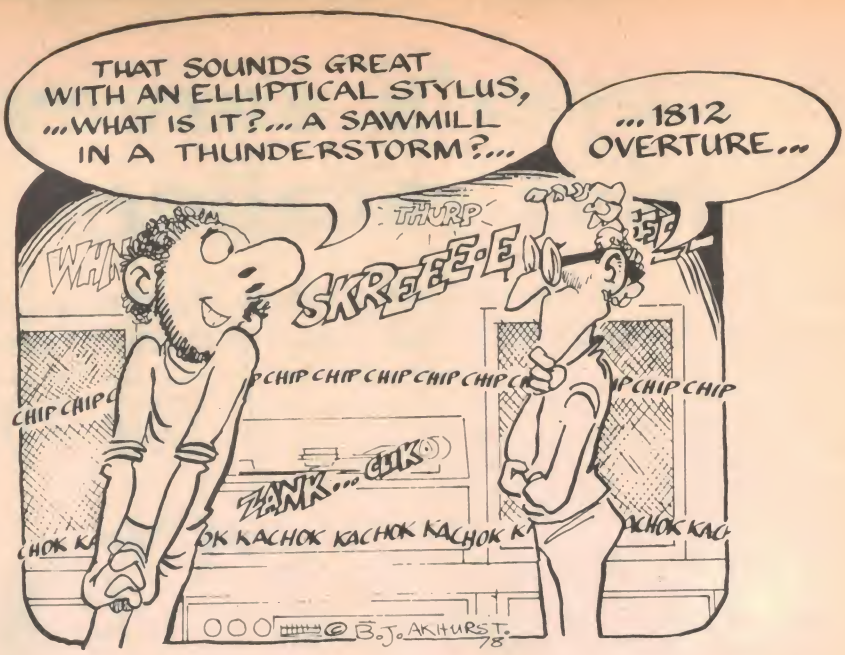
The system he came up with was the Harksound TT ($239), Aiwa AD-6550 cassette deck ($399), the Yamaha receiver ($395 special offer) and the AR14 at a price I've now lost. I had the impression that if any parts needed service, there wouldn't be any problem.

There was a listening room, but it had only the rather more expensive systems in it; my sort of price bracket was demonstrated in the front showroom, which obviously had its limitations, but there was only one demo at a time, and the traffic noise was not bad.

Despite the fact that the quantity of stock was fairly limited, I felt that one would get much better treatment here than at some of the other outlets visited.

Retailer No. 5, Brisbane

This store was a write-off. Even the outside didn't look too auspicious, with a garish window display advertising ▶



He's got the best job in the business.

Meet Keith Huxtable.

He's a fully qualified electronics engineer.

In fact, he's the best in Australia. That's why we employed him.

The problem is, that our equipment is also among the best in Australia. Because before it gets here it must undergo a series of stringent quality control checks.

Consequently, Yamaha equipment rarely needs repairing.

Which means Keith rarely has any work to do.

Still, turning the pages of Playboy can be quite strenuous!

YAMAHA

RM 186

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Photograph shows speakers without front grilles.

By assembling these speakers yourself you'll own far better speakers than you could have otherwise afforded (you save high labour costs) and you end up with a superb system that will delight you and your family.

TERMS are available to approved personal shoppers from a low 10% deposit and low monthly repayments.

Playmaster

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Each of the three Playmaster speaker kits were acoustically designed by Neville Williams (MIREE), Editor-in-chief of Electronics Australia magazine. They are precision manufactured by Dick Smith so that everything just about 'falls into place'. The four side panels are pre-joined to the vinyl cladding - they simply wrap around the front baffle board. Even if you've never built anything before, you can make a pair of these magnificent speakers in about 2 hours construction time.

The 6 page, profusely illustrated instruction brochure explains everything in a simple, step-by-step manner. Even a child can do it!

*Based on the price of the 300mm system in ready built form.

Specifications	200mm	250mm	300mm
Speaker Enclosure:	26 litre, infinite baffle	53 litre, infinite baffle	75 litre, infinite baffle
Dimensions in cm:	53.5(h)x32(w)x22.6(d)	62(h)x39.3(w)x29.3(d)	71.7(h)x47.5(w)x29.3(d)
Frequency Response:	45Hz - 20kHz	35Hz - 20kHz	28Hz - 20kHz
Impedance:	8 ohms	8 ohms	8 ohms
Power Rating:	40 watts music	60 watts music	80 watts music
Total System	**$149.50**	**$224**	**$284**

Sent anywhere in Australia for only $6.00 per pair freight.

DSE586

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ANY TERMS OFFERED ARE TO APPROVED APPLICANTS ONLY
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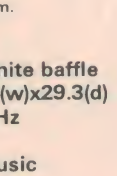


this week's specials.

The salesman asked me how much I wanted to spend, never bothered to ask what sort of music I liked, and tried to flog me the special Marantz offer which, as far as I could remember, was identical to the one Retailer No. 2 was offering.

He then took me to what looked like a listening room, (amazingly quiet, considering this store is in one of the busiest parts of Brisbane) but it occurs to me now that few of the systems were connected – certainly not interconnected, and no effort was made to demonstrate anything to me. In fact, I was *shown* another Marantz system, and asked if this was the sort of thing I liked the *look* of!

He then took me straight back to the shop, remarking on the way that they take people to that showroom to let them see what the assembled system will look like in their lounge rooms! Christ!

The exact reverse of the man at store No. 3, this one stuck to my budget with a vengeance. He started by recommending an amp rated at 60 watts RMS per channel, and when he couldn't quite fit that one into the price range, asked me what size my lounge room was (average), and said that a slightly smaller amp would do – 26 watts RMS. He fiddled with prices for a while and finally came up with a full Marantz system, plus cartridge, for $1485.

There was no attempt to sell me anything but Marantz (which was by far the largest proportion of their stock although they also had a small quantity of Sansui, Technics and others), telling me that they were "about the best". He asked me if I'd like to hear it, and I said "won't you have to set it all up?" or something of the sort, whereupon he said that it would be OK if I was "serious about buying it". I said I was only collecting information at that stage, so we agreed to give it a miss.

Retailer No. 6 Brisbane

This retailer was an altogether different kettle of fish to the last, having not only a hi-fi sales division, but a sizeable division dealing with service, accessories and so forth. They have a very good variety of stock, and don't seem to favour any one particular brand with the possible exception of TEAC in tapes and cassettes.

My salesman looked out of place here – more the sort of person you'd expect to see at 45 degrees to the pub counter at Urandangi – into the roll-yer-owns, and with a vocabulary that consisted mainly of bloody this, damn that and RS everything else, plus a lot of sound effects. A good job such language doesn't bother me, but I could imagine some people being put off by it. He was in some ways as opinionated as he was knowledgeable – "Technics turntables are RS" and so on.

I was here for an hour and a quarter, all of which was most interesting. He made a number of suggestions, pointing out the good points of some systems and dismissing others as "gimmicks – who needs 'em". He made a point of sticking to my budget of $1500, and started by asking what sort of music I (and my husband) liked.

He was the only person to ask during a demo whether the level he was playing the record at was the sort of level I'd be listening to at home (it was). There was a reasonable selection of classical records from which they let me choose one for demo purposes, suggesting that if I wanted a further demo, I was welcome to bring my own.

One point of interest about this store was a half-price hi-fi system on private sale: it seems that the owner was buying gear here, and on the principle that he could get more for his old deck than as a trade-in, he was given space for a specified length of time in which to make his own sale – which seems a very generous arrangement.

I was given a good, though not outstanding, demonstration of speakers: three Celef models and the small Bose. Even though the $750 Celefs would have fitted my budget, no attempt was made to sell me them in preference to the $560 Celefs, which to me sounded about as good. The "extra" saved went into a better cassette deck and, a separate amp and tuner.

The final system was the Connoisseur BD2/A TT ($179) plus Supex moving coil ($88) – no other TT was even suggested; TEAC A-103 cassette ($185) or A-105 ($219) or A-107 ($249); the Rotel RA-714 amp (about $270) plus matching tuner RT-726 (about $299) and the Celef Monitors ($560). Reviews of the turntable and speakers were supplied.

Conclusions

On the whole, things have greatly improved in the hi-fi sales business since I last did the rounds of hi-fi retailers in 1975, the one exception being retailer No. 5. Everyone (but No. 5) asked me what type of music I liked to listen to, everyone asked what size living room I had (even if they did ask rather late in the piece), and everyone but No. 5 gave a good to excellent demonstration of speakers.

Most were prepared to spend some time on a demo (with the exception of stores 2 and 5), and gave more than a minimum of good information.

Brisbane dealers are considerably friendlier and more easy-going than Sydney dealers, who seem very competitive (maybe because there *is* more competition down there – certainly the gear carried in Sydney stores is more expensive on the whole than in Brisbane). The largest stock doesn't necessarily imply the best service, as I found at retailer No. 3.

I didn't feel that I was being talked down to as a woman, although in most cases I started out acting dumber than I am, except at No. 5, who I suppose figured I was going to buy what looked nice. I can't say I had a very nice feeling at No. 2 either (or No. 3, but then I may be paranoid). Brisbane was, on the whole, better than Sydney in this respect.

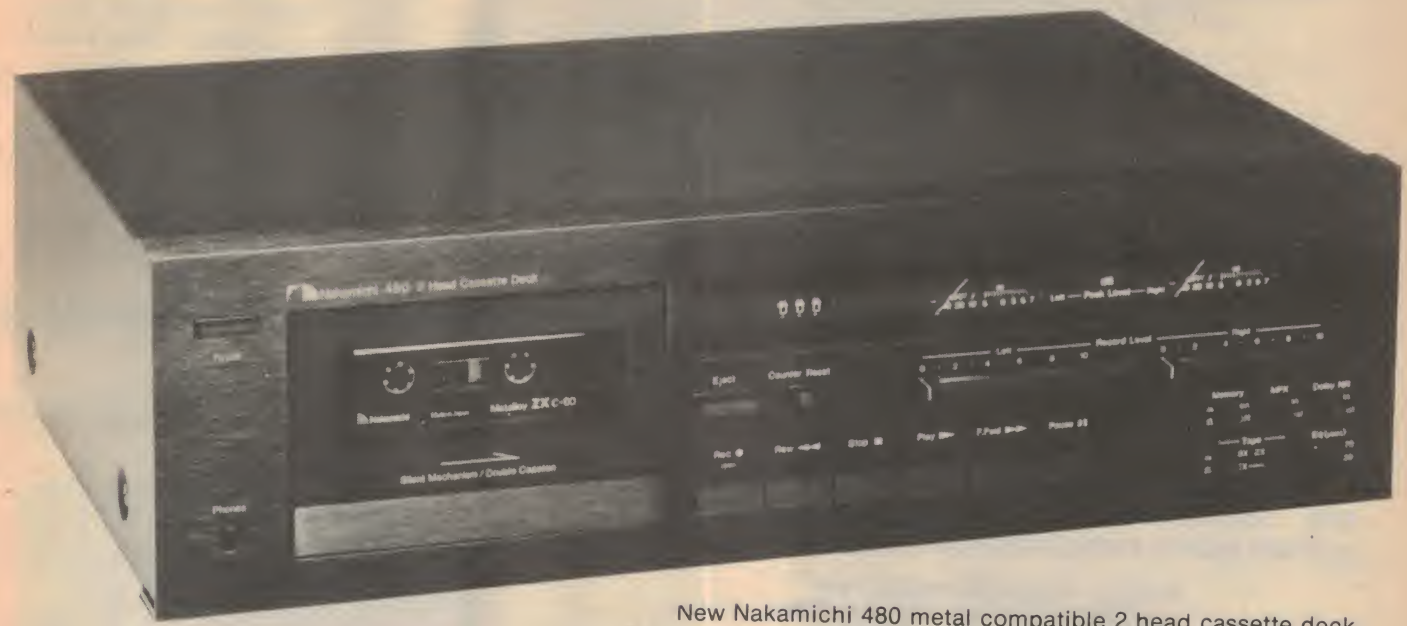
The best response I received to a bit of knowledge was with No. 4, where the more I seemed to know, the better the conversation became – they do seem to like their work there, and at No. 6.

The major problem I encountered was that there seemed to be too much pushing of one particular line (most likely to be Marantz or AR speakers), which happened in all six stores to a certain extent.

It seems to me that it would pay people who are in the market for reasonable quality gear to get some informed opinion *before* visiting the various retailers, and then go to at least two or three stores before buying anything – simply because everyone has a different opinion about what is good. For example, one salesman recommends Harksound TTs, another thinks they're crap; one says there's no difference between Akai and TEAC reel-to-reel tapes unless maybe Akai is better, another thinks TEAC has been miles better than Akai for at least eighteen months, and someone else thinks that TEAC has lost its grip.

About the only consensus of opinion I could find was that retailers 3 and 4 both think that Yamaha are the only good Japanese speakers, and that they are outstanding. Number 6 agrees with No. 4 (I think) that Cerwin Vega are fine for pop but a disaster for classical (and any twit can hear that). One does wonder just how much these opinions are influenced by what is in stock – that is, do they like what they stock, or stock what they like? Probably a bit of both (licensing agreements aside), but it does indicate that informing yourself first and then shopping around make a lot of sense when you are thinking of spending that much hard-earned lolly. ●

The $399* Nakamichi



New Nakamichi 480 metal compatible 2 head cassette deck.

If you know Nakamichi products, you'll know $399* sounds too cheap for real Nakamichi quality. But if you know Nakamichi, the man, you won't be that surprised.

Nakamichi's genius for innovation has created a new Nakamichi range that makes brilliant reproduction at incredibly reasonable prices a reality.

Take the new 480. It is the personification of Professor Nakamichi's latest technology and his policy of producing components with an excellent performance/cost ratio.

Nakamichi 480 can play and record conventional and the new metal tapes and is available with an optional remote control unit. It has a frequency response of 20Hz-20KHz (-20dB Rec. level), wow and flutter less than 0.11 percent WTD peak, 0.06 percent WTD rms, signal to noise ratio (Dolby NR In, 70us) — better than 62dB at 400 Hz, 3 percent THD WTD rms, cross-talk better than 60dB at 1 KHz, OdB, erasure better than 60dB below saturation level at 1 KHz and total harmonic distortion less than 1.0 percent at 400Hz, 0dB (ZX, EXII tapes) and less than 1.2 percent at 400 Hz, 0dB (SX tape).

And if you're not sure about all that technical jargon, it means, quite simply, that the Nakamichi 480 performs brilliantly. But don't take our word for it. Experience the difference Nakamichi technology makes to high fidelity sound reproduction by visting your nearest Nakamichi dealer.

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Products of unusual creativity and competence.

For further information contact:
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*Recommended retail price

Good News!!!

ADVENT is here again.

Some years ago **ADVENT LOUDSPEAKERS** were sold in Australia and it was a great disappointment to many when they disappeared from our market.

ADVENT are remembered for that superb **"TRUE TO LIFE"** quality that all good Loudspeakers should have.

Now better than ever. From the **NEW ADVENT LOUDSPEAKER** (the new version of the speaker that has been the most popular and imitated model in the U.S.A.) to the **ADVENT 3**, there are 5 models . . .
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ADVENT

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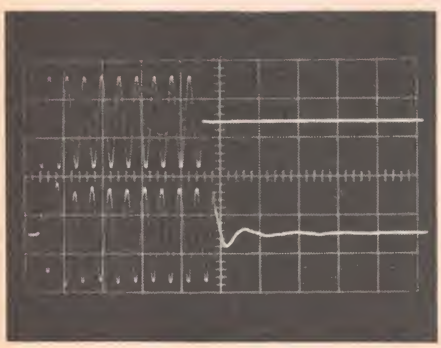
The 'New' Advent loudspeaker

This model is ". . .at least one order of magnitude better than the old Advent . . . produces . . . the cleanest . . . sound of any speaker in the under $1000 bracket".

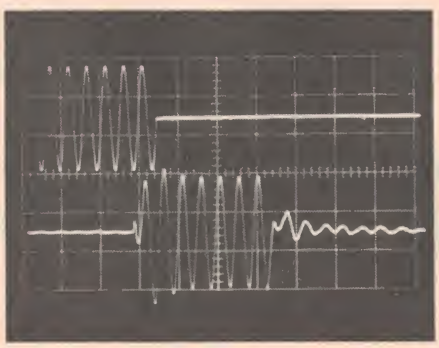
IT WAS in November 1971 that we first reviewed the Advent loudspeaker. At that time the two loudspeakers that impressed us most in the lower priced end of the speaker market were undoubtedly the larger Advent and the Acoustic Research AR6. In terms of value for money, quite apart from listening pleasure, those two speakers were very high up on the list of our favourite speakers. Surprisingly, in the intervening period, both the Advent and the AR6 speaker systems disappeared out of the local retailers' show rooms and we felt that the market place suffered as a result. The factor that most impressed us with the first Advent loudspeaker was the quality of its extended bass response, its overall definition and moderate colouration over the entire spectrum.

In the last eight years the Advent Corporation has undergone major changes. Not surprisingly, the Advent loudspeaker system has undergone similar changes. The re-appearance of the Advent loudspeaker system, billed as "The New Advent Loudspeaker", obviously caught our interest as much as we think it will capture yours.

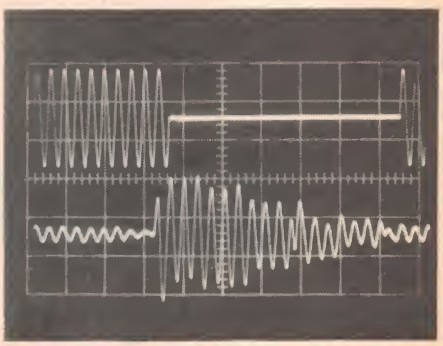
Advent, Acoustic Research and a number of other speaker manufacturers have designed excellent loudspeaker systems based on acoustic suspension of the main drivers. The enclosure in which the loudspeakers are mounted is made air-tight and the air trapped behind the very flexible low frequency driver (the woofer) acts as a spring to control the very long excursion of the voice coil particularly at the very lowest frequencies of the bass register. By careful design of the enclosure, the inter-connections and characteristics of the magnetic circuit of the bass driver, and the edge treatment of the speaker, the efficiency of such speakers can be significantly enhanced. This has almost reached the point where the old axiom that acoustic suspension systems are inefficient is no longer completely accurate. Through innovative design of the high frequency elements in such speakers, the problems of frequency linearity, power dissipation and transient response can be significantly improved when compared with the speakers available only a decade ago. The last ten years have seen a number of dramatic advances in speaker design.



Tone-burst response at 100 Hz (10 ms/div.)



Tone-burst response at 1 kHz (2 ms/div.)



Tone-burst response at 6.3 kHz (0.5 ms/div.)

The most significant to us, in assessing the Advent, are the advances in speaker crossover design, power dissipation and frequency linearity of the tweeters, the overall efficiency and minimisation of unwanted resonances of the speaker system as a whole.

When we originally reviewed the Advent loudspeaker and the AR6, both manufacturers made a strong selling point of the use of the minimum number of loudspeakers necessary to cover the frequency range. Each had only two speaker components, namely a bass driver and a tweeter. These effectively covered the frequency range from 40 Hz to 16 kHz. Surprisingly, AR and a number of other manufacturers have drifted away from this principle whilst Advent have not. Obviously, it can be a particularly complex task to design two speaker elements (one for low frequency and the other for high frequency) which can adequately cover such a broad frequency range of 2½ decades.

Experience has shown us that if this can be achieved, then the resulting transient and subjective characteristics observed by the listener are enhanced. Exhaustive listening tests, conducted under the auspices of the IEC TC29B WG9, have shown that many of the most experienced musical listeners tend to prefer loudspeakers with a smaller number of drivers rather than with a larger number of drivers. Obviously, such preference can be modified by the quality of the crossover networks and the type of drivers but the simple conclusion still appears to be valid.

The Advent Corporation have apparently accepted this viewpoint and have set out to market a loudspeaker which they claim is markedly superior to the original Advent loudspeaker. You might well ask what have they done to achieve this.

The first thing that they did was to improve the cone surround and magnetic circuit of their low frequency driver, thereby improving the efficiency of the system. The second was to incorporate a felted cone to provide higher strength for the speaker diaphragm and improved transmission loss for the acoustical energy within the cabinet being radiated to the outside environment. The third improvement was to incorporate a much heavier magnetic structure (which critically damps the speaker) in conjunction with the new cabinet volume, and the fourth was to incorporate the double-wound, four-layered voice coil. This is much longer than the original and thus provides better linearity with the very high excursions which are required by the speaker to extend its frequency response down to the 30 Hz region, which is the effective lower limit of the system's operation. The low frequency driver covers the frequency range 30 Hz to 1.5 kHz which, in realistic terms, is not asking too much of a 300 mm driver. Whilst none of these improvements in the low frequency driver could be classified as "state of the art" they are nonetheless all applications of well proven and practical principles of speaker design.

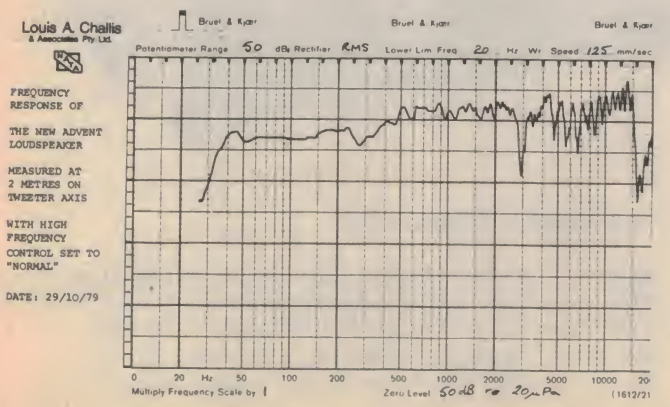
It is in the area of the tweeter design where Advent have made use of some "state of the art" treatments. A tweeter that can cover the frequency range 1.5 kHz to 15 kHz or more, is not unusual, but one that can do so with better transient response, better power dissipation and with an overall frequency dispersion characteristics that is genuinely improved, is another matter. Advent have set out to design a tweeter which is an order of magnitude better than their old one and equal to or better than anything else currently on the market. To achieve this aim, they have modified the front face of the tweeter to take the form of a rolled ring which provides a more linear cone excursion and much better frequency dispersion across the overall frequency range. They have dramatically improved heat dissipation and magnetic damping through the use of a magnetic or ferro-fluid injected in the air gap. When we first saw samples of the ferro-fluid in America at the AES Conference in Los Angeles in 1978 we foresaw that this material would provide many manufacturers with a concept that would radically improve their products.

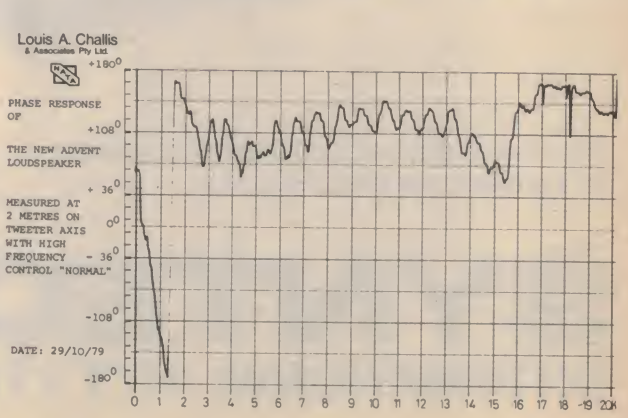
The new Advent speaker is the first of the products we have evaluated to incorporate this concept. The two drivers and the simple LCR crossover network design also provide a simple high frequency balance adjustment between two possible contours.

The cabinet is a solidly made walnut veneered particle board enclosure which still features the same classic appearance with contoured front edge that the original Advent speaker offered.

Evaluation

Our first series of frequency response tests in the anechoic room provided a result which is truly outstanding. The on-axis frequency response is essentially flat, ±4 dB from 32 Hz to 15 kHz and with a usable performance all the way to 20 kHz. The performance at 30° off the main axis is every bit as good as the on-axis performance. The internal frequency contouring control provides a typical 3 dB boost over the range 2 kHz to 20 kHz and offers as much adjustment as most listeners could ▶





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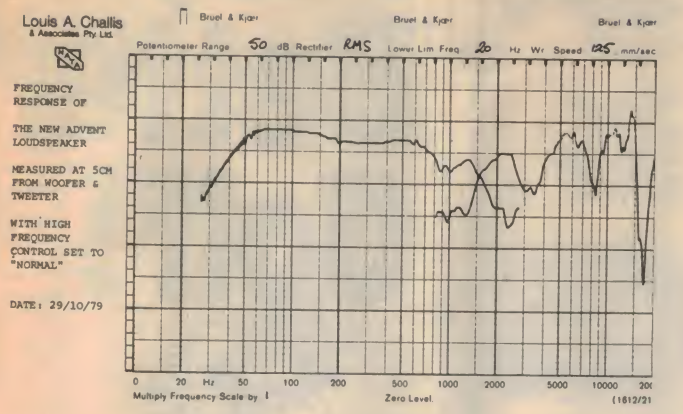

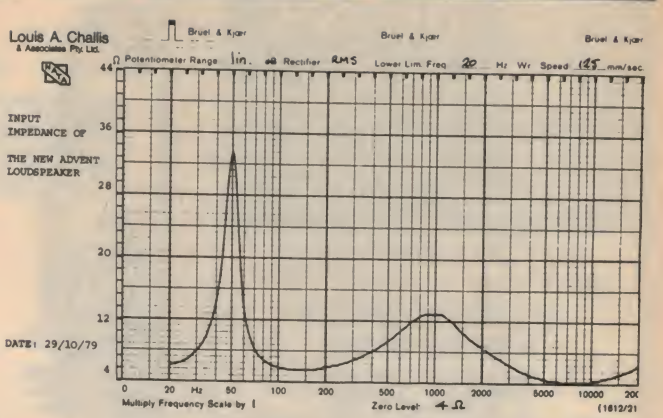

reasonably ask for from the speaker system (as opposed to the amplifier). The linearity of the low frequency response in the 40 Hz to 1.5 kHz range is remarkably flat and there are many so called "monitor" loudspeakers which do not even begin to approach this performance.

The phase response of the speaker system is truly outstanding, lying within ±90° from 150 Hz to 20 kHz. The frequency and phase linearity of this system are not only unusual but are directly related to the sound quality of the system. The impedance characteristics of the speaker are acceptable but the value of 4 ohms limits or excludes the number of additional speaker systems that could be connected in parallel.

The measured efficiency of the speaker is moderate with 1 watt of pink noise producing a low, but extremely flat, total radiated power bandwidth lying within ±3 dB from 40 Hz to 12.5 kHz. The distortion characteristics are good with less than 0.64% distortion at 100 Hz; 0.36% distortion at 1 kHz; and 0.47% distortion at 6.3 kHz. Even the tone burst testing was good, except at 6.3 kHz where the results were not quite as good as we might have expected.

The subjective assessment of the Advent loudspeaker was just as pleasant as the objective testing. The smooth low frequency performance was immediately apparent whilst the lack of colouration and distortion at both low and high frequencies is a credit to the system's designers. The bass response is *better than many loudspeakers costing two to four times the price*. The high frequency response, which is remarkably clean, is obviously enhanced significantly by the ferro-fluid in the air gap of the driver. Whilst we did not try to destroy the speaker we had no difficulty in driving it with amplifiers with power ratings significantly above the manufacturers' recommended minimum figure of 15 W. With a 150 W rating amplifier we drove it to rollicking levels of over 100 dB on soft rock and modern pop music. The speaker gave no indication of thermal distress or even excessive distortion. Whilst the speaker is obviously designed primarily for residential usage, our assessment leads us to believe that 100 W of music power is well within its scope. (It should be noted that the manufacturer and agents do not specifically recommend such usage!).

We evaluated the new Advent with selected samples of a wide range of recorded music. The colouration of the system is apparent but much lower than many of the other top-line speakers we have evaluated. When the original Advent speaker was compared against the AR6, the AR6 shone because of its lower colouration. That comparison would no longer be valid, as the old Advent has been positively eclipsed by the new Advent speaker system.

Summary

Our overall impression of the new Advent speaker is that it is at least one order of magnitude better than the old Advent. This system produces some of the cleanest and most uncoloured broad-band sound of any speaker in the under $1000 bracket.

THE NEW ADVENT LOUDSPEAKER

Dimensions: 660mm high x 360 mm wide x 292mm deep

Weight: 20kg *Price: $599*

Manufactured by Advent Corporation, Cambridge, Massachusetts, U.S.A.

Louis A Challis and Associates Pty Ltd

MEASURED PERFORMANCE OF

THE NEW ADVENT LOUDSPEAKER, S.N. A422471

FREQUENCY RESPONSE: 40Hz to 15kHz ±4dB

CROSSOVER FREQUENCY: 1500Hz

SENSITIVITY: 9.6V RMS
(for 90dB average at 2m) = 15 Watts nominal (6Ω)

TOTAL RADIATED POWER RESPONSE: (see graph)
(Average power radiated through a hemisphere)

HARMONIC DISTORTION:
(for 90dB at 2m)

	100Hz	1kHz	6.3kHz
2nd	-28.6dB	-61.1dB	-47.8dB
3rd	-46.3dB	-49.2dB	-52.9dB
4th	-49.2dB	-66.1dB	-77.7dB
5th	-52.8dB	-61.9dB	-
THD	*0.64%*	*0.36%*	*0.47%*

INPUT IMPEDANCE:

100Hz	6Ω	
1kHz	13Ω	
6.3kHz	4.5Ω	
Minimum:	4Ω	(8kHz)

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New Smooth AD 01631/T8 50W RMS Textile Non Exposed Dome

Woofers — 300 mm High Power.
New AD 12650/W8 60W RMS
New AD 12200/W8 80W RMS
New AD 12250/W8 100W RMS

Squawkers — High Power
AD 5060/SQ8 40W RMS 125 mm Cone Sealed Back
AD 0210/SQ8 60W RMS 50 mm Dome Sealed Back
New AD 02160/SQ8 80W RMS 50 mm Dome Sealed Back

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The Sirius System 1400 loudspeaker enclosure

This system offers good dynamic range, transient response and frequency response, with moderate colouration. It should be popular for both classical and modern pop music.

THE SIRIUS RANGE of loudspeakers evolved from the Philips Elcoma series of speaker kits. These kits have developed over the last 20 years as one of the most well-known sources for "do-it-yourself" loudspeakers. Whilst there are many who prefer to build their own systems, the majority of the market is still catered for by factory-built and assembled speaker systems. Philips in Eindhoven, Holland, have been a prolific source of new designs, obviously based on the Philips driver components and cross-over networks.

The design

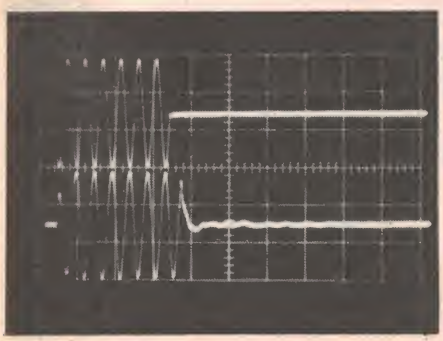
The Sirius system 1400 is one of the largest Philips consumer-orientated three-way systems to emerge in the last few years. The system makes use of a 300 mm low frequency driver, an AD12100/W8 woofer, and AD0210/SQ8 mid frequency driver and the ubiquitous AD160/T8 tweeter to cover the top end.

Philips carried out extensive developmental work to provide an improved cross-over network which correctly balances the different characteristics and efficiencies of the component speakers so that the resulting output would be well balanced and adequately matched to satisfy the requirements of a high powered system. The Series 1400 takes these three speakers and mounts them in a rather large enclosure designed to provide a good frequency response down to 35 Hz. The design criteria for the system is only a little different from many previous Philips systems in that the crossover network design philosophy aims at providing a constant input voltage to each set of speaker terminals over the design pass-band for that speaker. The out-of-band attenuation is designed with a sharp skirt which extends from the crossover frequency to at least one octave above and below the upper and lower crossover frequencies respectively.

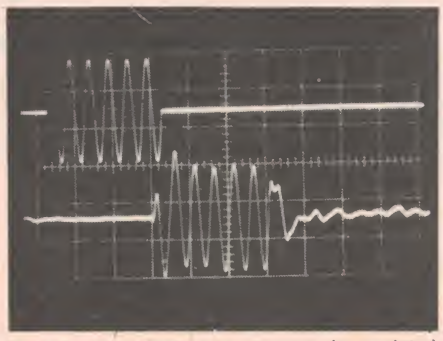
Beyond those limits the stopband attenuation is allowed to fluctuate to within 10 dB of the pass band level. This minimises the inter-action between each driver to provide the best possible polar and phase responses.

In lieu of the more conventional simple LC crossover networks the designers have introduced a series of LC pairs. These provide a series resonance at frequencies between half and one octave above and below the crossover frequencies. By introducing an additional resistor in series, the low frequency driver (which is very efficient) has its output attenuated to match the midband output of both the mid-range driver and the tweeter as well. Each of the drivers utilised in this system have frequency responses which are not particularly flat. Both the mid-range driver and the tweeter have responses that are relatively "peaky" because of their integral rear enclosures and the designer has been prepared to accept this factor to provide a system which offers other attributes in terms of transient performance and power handling capacity.

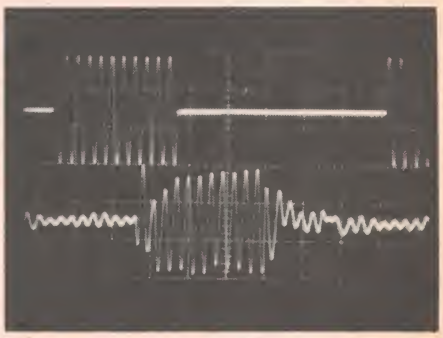
The appearance of the Sirius 1400 Speaker System is neat and attractive. The particle board enclosure is finished with a simulated walnut veneer which provides a finish which is of a much higher standard than normally achieved with genuine wood-veneered enclosures. Not only is the front finished in this manner but the back and sides are also



Tone-burst response at 100 Hz (20 ms/div.)



Tone-burst response at 1 kHz (2 ms/div.)



Tone-burst response at 6.3 kHz (0.5 ms/div.)

finished to the same standard. We have come to expect this from the better Japanese and American manufacturers but not from Australian manufacturers. The front removable panel is also well finished. It incorporates a curved edge frame over which a very open weave black cloth is stretched. This grill cloth provides negligible insertion loss to the radiated sound. The grill cloth panel clips onto the enclosure with four simple catches. These are quite effective and facilitate easy removal of the front panel for access to the tweeter and mid-range attenuators located on one side of the mid-range driver and tweeter. These each provide ±2 dB adjustment over the operational range.

The three drivers, woofer, mid-range and tweeter are sensibly arranged in a vertical line, whilst the two attenuators are offset on the left side of each of the top two units. Whilst the AD0210/SQ8 mid-range is a relatively new arrival on the scene, the AD0160/T8 is the latest version of the very successful range of dome tweeters that Philips developed more than 12 years ago. The rear of the cabinet contains a recessed plastic moulding with two spring-loaded colour coded terminals for connecting bare speaker leads.

Evaluation

The objective testing of the system proved to be particularly interesting. We were not surprised to find that the frequency response of the overall system was only moderately flat and that the individual characteristics of each of the drivers shows through clearly in the composite frequency spectrum measured in the anechoic room. Both the mid-range driver and tweeter exhibited fairly significant "peakiness" in the middle of their respective pass bands and detract a little from the visual impression that the level recordings displayed.

The Sirius System 1400 is a three-way pressure-box design using the AD12100/W8 woofer, AD0210/SQ8 mid-range and the AD160/T8 drivers.

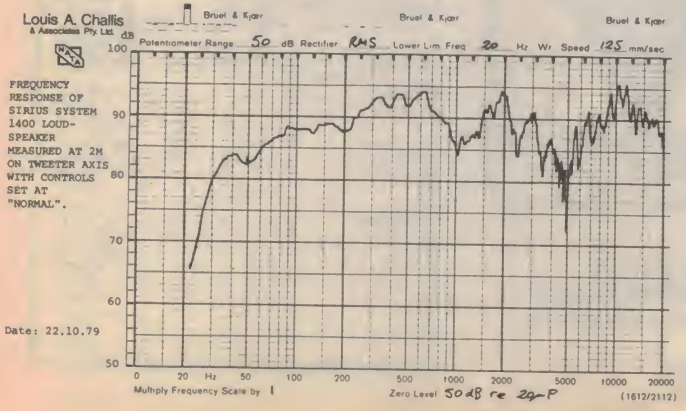
The crossover notch between the low frequency driver and the mid-range driver is not readily detectable on the level recordings whilst the crossover between the mid-range driver and the tweeter is readily detectable. Notwithstanding, the frequency response extends from 35 Hz to over 20 kHz, although the overall flatness is not as smooth as we have seen from other Philips systems. The phase response is however remarkably smooth and it is obvious that the designers have gone to considerable trouble to achieve such a commendable performance in this regard. The overall phase response lies within a 225° spread from virtually the low frequency resonance point all the way to 20 kHz.

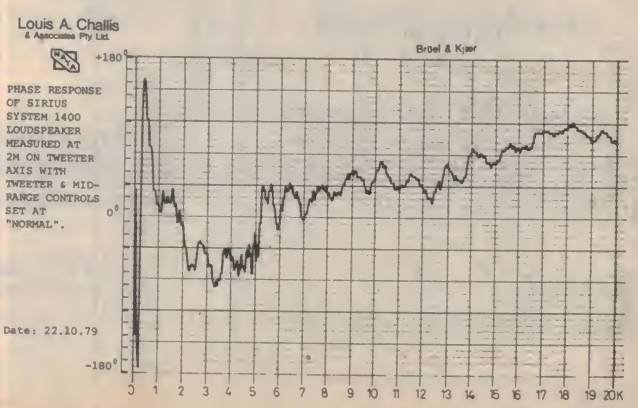
The total radiated sound power measured by the 12-point array method in the anechoic room shows that the frequency response is effectively within ±6 dB from 35 Hz to 18 kHz. This is quite an acceptable performance. The individual drivers' characteristics do show up in the overall balance of sound dispersion that the system is capable of providing.

The distortion characteristics of the system are also quite acceptable with the individual harmonic at 90 dB output at 2m being less than 2% at 100 Hz and 1.1% at 1 kHz. The impedance of the speaker drops to 6.5 ohms nominal at 2 kHz and thus the correct rating of the speaker system should be classified as a nominal 6 ohm, rather than an 8 ohm, speaker system. This system can still be paralleled with a second speaker system provided that its impedance is 8 ohms. Tone burst testing of the speaker indicates that its transient performance is acceptable and the overall objective testing showed this speaker to have few vices and many commendable features.

Listening tests

The subjective testing confirmed that the speaker has a good dynamic range and is capable of accepting input powers in excess of 25 watts RMS and 'music powers' that are significantly higher than that figure. Driven by a twin 80 W amplifier, the system was readily capable of providing peak levels of in excess of 100 dB without gross distortion. The low frequency driver in particular is remarkably smooth in its performance. By contrast, the mid-range provides a degree of colouration which is readily detectable on speech, singing ▶





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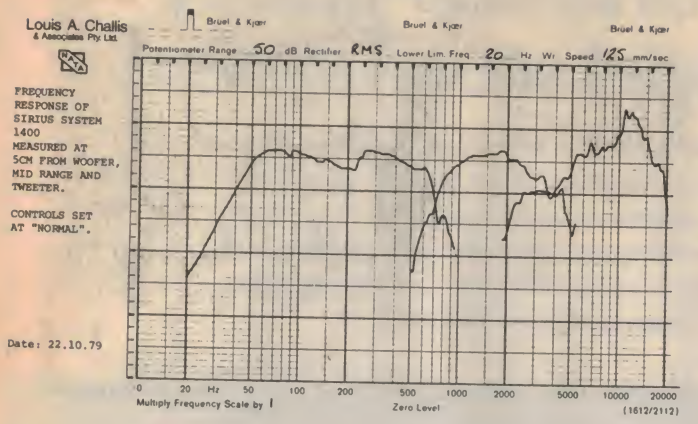
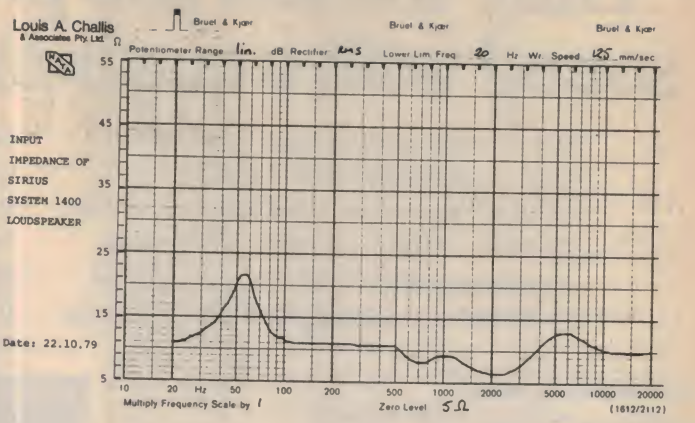




and on guitar music. Although the tweeter is not flat its frequency characteristics are not as readily detectable as is the mid-range driver. The speaker presents its subjective mid-range in a manner which is not unlike the Altec Lansing and JBL consumer range of speakers. Those people who prefer the presence of those speakers will be particularly pleased with this system.

We carried out a series of listening tests to evaluate the type and characteristics of the colouration. On spoken words and singing, as previously noted, the colouration is quite apparent whilst on instruments such as woodwind and horns, it is not readily apparent at all. We found that the colouration was not disturbing and believe that the majority of listeners will like the timbre of its sound which is enhanced by the good transient response.

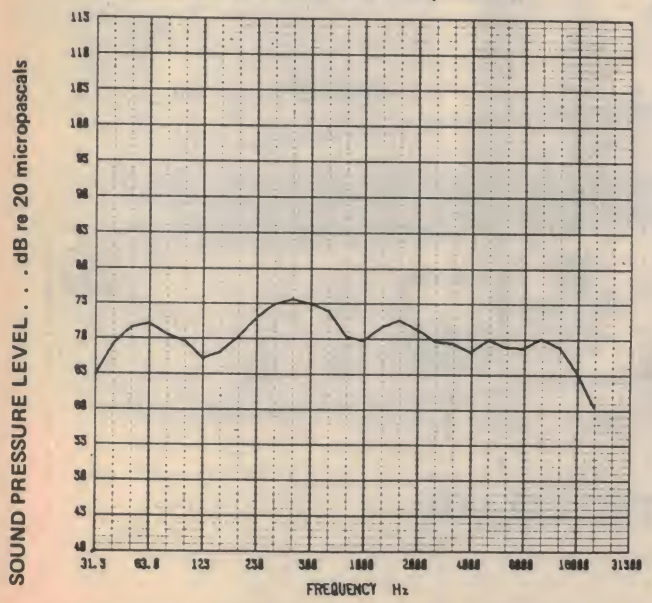
Summary

The Sirius 1400 Speaker System is a particularly well designed unit. It offers a very good frequency response and moderate colouration. It has a very good transient response and overall attributes which we believe will make it very popular for classical music and most particularly for modern pop music. ●

THE SIRIUS SYSTEM 1400 LOUDSPEAKER ENCLOSURE

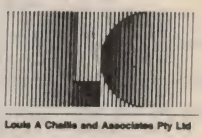
Dimensions: 720mm high x 460mm wide x 265mm deep
Volume: 82 litres *Weight: 19kg*
Price: $590 per pair
Manufactured by L. & D. Audio Acoustics P/L, Padstow, N.S.W.

TOTAL RADIATED POWER OF SIRIUS SYSTEM 1400 LOUDSPEAKER
measured at 2m radius with 1W pink noise



AVERAGE OF 12 SPECTRA EQUALLY DISTRIBUTED OVER A HEMISPHERE. Overall level: 85.8 dB (Lin), 83.8 dB (A)

MEASURED PERFORMANCE OF
SIRIUS SYSTEM 1400 LOUDSPEAKER ENCLOSURE



FREQUENCY RESPONSE:	40Hz to 20kHz ±6dB			
CROSSOVER FREQUENCIES:	700Hz; 3.5kHz			
SENSITIVITY:	9V RMS			
(for 90dB average at 2m)	= 10 Watts nominal			
TOTAL RADIATED POWER RESPONSE:				
(for average power radiated through a hemisphere)	40Hz to 12.5kHz ±4odB (see graph)			
HARMONIC DISTORTION:		100Hz	1kHz	6.3kHz
(for 90dB at 2m)	2nd	-41.2dB	-42.1dB	-48.8dB
	3rd	-39.3dB	-43.7dB	-49.6dB
	4th	-57.9dB	-71.5dB	-
	5th	-49.4dB	-66.5dB	-
	THD	*1.4%*	*1.0%*	*0.5%*
INPUT IMPEDANCE:	100Hz	11.5Ω		
	1kHz	9Ω		
	6.3kHz	12.5Ω		
	Minimum:	6.5Ω	(2kHz)	

Date: 6/11/1979

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(Main Frame B-2000 plus choice of Units)

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Preamplifier Section: Microphone Preamplifier (2051), Microphone Preamplifier with Compressor (2052), Phono Preamplifier (2054), Auxiliary Preamplifier (2054), Balanced Line Input Preamplifier (2056).
Power Supply Section: Power Supply Unit, 500 mA max. (2081), Power Supply Unit, 1A max. (2082).
Signal Generating Section:
Chime Units—A series of 4 notes (2011), 1 note (2012).
Signal Generators—Pink Noise/400Hz/1KHz (2013).
Siren/Yelp/Buzzer (2014).

1/3 Octave Equalizer (E-2300)

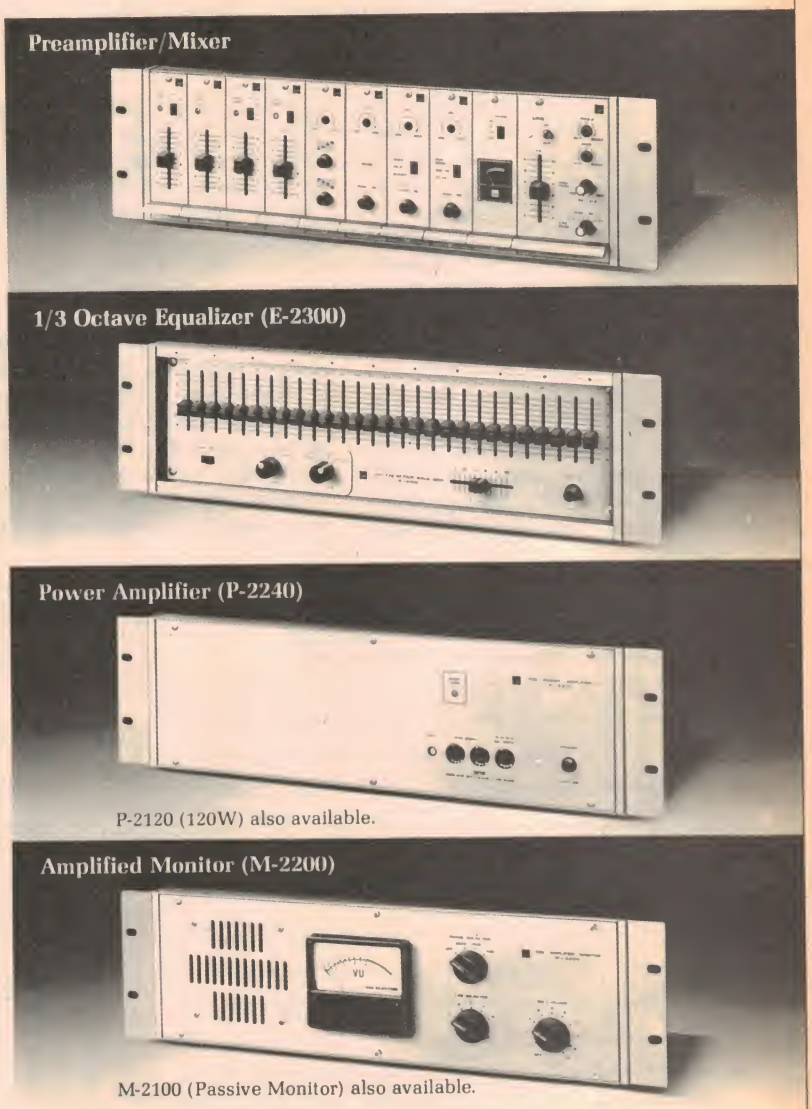
Ideally tailors sound system frequency response to listening area acoustics. Consists of 28 active inductorless band rejection filters from 31.5Hz to 16,000Hz. Attenuation for each filter is 15dB, and crossover between adjacent filters is −7dB.

Power Amplifier (P-2240)

Delivers 240W RMS continuous power into 8 ohms with less than 0.25% THD over 20—20,000Hz. Features include balanced and unbalanced 15,000-ohm inputs, full protective circuitry, front-mounted AC/DC fuses and two LED indicators for power and overload (power LED turns from green to red for excessive temperatures or voltage drift). 120W amplifier also available (P-2120).

Amplified Monitor (M-2200)

Equipped with large, easy-to-read VU meter and 4" high-compliance speaker. Controls include 4-position meter range selector (20dB, 10dB, 0dB, OFF), 5-position line selector and speaker volume control. Passive monitor also available (M-2100).



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NOTE: This offer is made by Dindy Marketing (Aust.) Pty Ltd and this publication is acting as a clearing house only. Cheques should be made payable to 'Ampex Tape Offer' and sent, together with the order form or accompanying letter, to 'Ampex Tape Offer', c/o ETI Magazine, 15 Boundary Street, Rushcutters Bay NSW 2011. We will then process your order and pass it on to Dindy, who will send you the goods. Please allow up to four weeks for delivery.

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DREGS

TECHNICAL ENQUIRIES are part and parcel of the everyday running of a magazine such as this. We are generally glad to answer queries by letter or phone (between 4 pm and 5 pm only!) as they sometimes point out both weaknesses and strengths in project or feature presentation and help us improve the magazine — which is to everybody's benefit.

Queries can generally be said to fall somewhere between the two extremes of gross amusement and gross annoyance — these two limits being the upper and lower deciles (top and bottom 10%), respectively, of that well-known tool of statisticians, the Gaussian curve. That is to say, the larger number of technical queries are routine, answered simply and directly, without fuss. Those which cause gross annoyance we won't dwell on here. Dregs is not, by nature, pessimistic and should not be a soapbox for the airing of gripes . . . unless they are amusing (see October's Dregs).

One phone query recently, (and this is where the story really starts . . . as Wallace Greenslade relates on that memorable Goon Show — "Dishonoured") caused a certain amount of helpless hilarity one afternoon in the office. The hilarity did not arise in the nature of the query, rather, in the dialogue that took place. One should not laugh at another's misfortune, and indeed, nobody did. The caller had purchased an ETI-470 60 W low distortion power amp module kit and assembled it as per the instructions. All well and good. Came the testing . . . and disaster befell our (now crestfallen) constructor.

At this stage, he rang to clear up a few points that didn't seem, to him, to be clear.

The editorial staff have desks sited quite close together and, on the afternoon in question, everyone was at their desks. David Tilbrook took the call, and this is what the erstwhile "gallery" overheard:

"The 470 amplifier; yes".

"The output transistors . . . get warm? Oh, yes, that's quite normal. They're meant to get a little warm when they're operating".

Followed by, in the same polite tone —

"They caught fire? No. That's not normal".

Immediately, there were great guffaws of laughter, gaspings for breath, fallings from chairs and other evidence of helpless hilarity.

In the midst of this, David took a short pause to maintain his composure — a truly Herculean effort, considering the events around him — desperately trying not to give offence to the reader who had suffered such a misfortune.

It seems the constructor, and his mate who was somehow involved, took the catastrophe in their stride. As the mate confided, in his matter-of-fact manner, "Gee, they really went up . . . lucky we were over the other side of the room!"

Lest other readers with 470s, or yet-to-be-built kits of same, worry, the problem lay in the particular construction. A heatsink without a planar surface was used, resulting in poor thermal contact to the bias stabiliser, Q8. The output stage went into rapid thermal runaway. Suffice to say that a heatsink of the type specified should be used and Q8 properly mounted to the heatsink.

We sincerely sympathise with the unfortunate constructor and hope no offence was (or is) taken.

Please excuse the shaky typesetting.

More queries

One of our more extraordinary project queries was received some time back by ETI's UK edition. A brusque military-sounding type complained that he'd assembled a fairly basic project precisely as shown in the magazine — but it didn't work at all dammit!

The staff member taking the call ran through all the usual questions but was rather surprised at the increasingly trenchant manner of the enquirer — who eventually said that he was an ex-naval engineer who 'knew what he was doing', the thing doesn't work 'and dammit I want to know why!'

Eventually ETI agreed to physically inspect the offending project. It had indeed been precisely assembled. Every component was in the right position, every lead turned at an exact right angle. Nothing to criticize or possibly cause a fault. Except for one thing.

Every single connection had been made with Araldite.

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